AVIATION

The Oldest American Aeronautical Magazine

NOVEMBER, 1930

25 CENTS PER COPY

A McGraw-Hill Publication

AVIATION
A McGraw-Hill Publication — Est. 1916

The Oldest American Aeronautical Magazine

Edward P. Warner, *Editor*

Louis F. Stoll, *Publishing Director*

CONTENTS FOR NOVEMBER, 1930

Volume 29 Number 5

The Future of Air Navigation — 264
A critical presentation of air transport problems by a famous pilot and some novel suggestions for solutions. — By Capt. Frank T. Courtney

Flight Instruction and Flight Theory — 269
The first of two articles on the advisability of giving the student highly specialized ground instruction — By W. F. Gerhardt

The S.A.E. Discusses Fuel — 273
A symposium of the S.A.E. considering the economical justification of higher grades of fuel for aircraft — By Leslie E. Neville

The Tour in Retrospect — 278
Some interesting comments on the good and bad features of the 1930 commercial air classic — By John T. Nevill

How I Flew the Tour — 281
Personal comments by the men who piloted a Ford transport to first place in the National Air Tour — By Harry L. Russell

Crash Fire Tests with Diesel Oil — 283
The results of tests conducted to determine the relative inflammability of Diesel oil and gasoline — By C. Fayette Taylor and Edward S. Taylor

Air Transport Development in Latin America — 286
A detailed account of the air transport operating activities south of the United States — By H. Case Willcox

The Story of Wichita — 291
The second of a series of articles dealing with the city's interesting aeronautical history — By John T. Nevill

Airplane and Engine Specifications — 307
Eight pages of tabulated data of commercial airplanes and of engines available for commercial use

EDITORIALS — 266
THE TRENDS OF ACTIVITY (NEWS) — 259
STATISTICS OF THE MONTH — 301
SHOP NOTES AND TECHNICAL DATA — 296
NEW EQUIPMENT — 301
WHAT OUR READERS SAY — 303
THE SKYREES' LOG BOOK — 304
NEW CATALOGS — 304
ABSTRACTS AND REVIEWS — 305
SIDE SLIPS — 306

Published monthly. United States, Canada and Mexico $5.00. Central and South America, $6.00 a year. All other countries $8.00. 50 cents a copy. Entered as second-class matter July 17, 1916 at the Post Office at New York, N. Y. under the Act of March 3, 1879. Printed in U. S. A.

James H. McGraw, Chairman of the Board
Malcolm Muir, President
James H. McGraw Jr., Vice-Pres. and Treas.
Howard J. Meredith, Vice President
Mason Britton, Vice President
Roman Kohak, Vice-President
Harold W. McGraw, Vice-President
H. C. Parmelee, Editorial Director
C. H. Thompson, Secretary

McGraw-Hill Publishing Co., Inc.
Tenth Ave. and 36th St.
New York, N. Y.
Cable Address: Machinist, N. Y.

New York District Office, 285 Madison Avenue
Boston 1427 Statler Building
Washington National Press Building
Chicago, 520 N. Michigan Ave.
Philadelphia, 1600 Arch Street
Cleveland, 601 Guardian Building
Detroit, 3-317 General Motors Building
St. Louis 1000 Bell Telephone Building
Greenville, S. C., 1001 Woodside Building
San Francisco, 883 Mission Street
Los Angeles, 816 Chamber of Commerce Bldg.
London, 6 Bouverie Street, London, E. C. 4

AVIATION
A McGraw Hill Publication Est 1916

The Oldest American Aeronautical Magazine

EDWARD P WARNER *Editor*

VOLUME 29 . . . *November, 1930* . . . NUMBER 5

A PLATFORM FOR PROGRESS

A FEW years ago, when organized baseball was afflicted with a grave scandal, the reaction of the typical bleacher devotee was summarized by a small boy in a historic plea. He stood by the edge of the curb as one of his heroes passed en route from the District Attorney's office, and gazing at him with adoring eyes he begged: "Say it ain't true, Joe."

It does not take a scandal to evoke that sentiment. It is the typical response of the typical business man or speculator to a business depression. The first six months of every bear market and of every industrial collapse are consumed in looking for somebody to say it ain't true.

Most of us in the aviation business have finally emerged from that state of mind during the present summer or fall. Most of us are quite prepared to concede the blunders of the past and to evolve some brand new policies for the future. The aircraft industry has been on an unsound economic footing, the natural result of overexpansion and of an excess of public enthusiasm. The chart by which we set our course in 1929 has proven in many cases unworkable. We have to develop a new set of aids to navigation. What does the industry really need?

The present year has been one of retrenchment and of reduction of overhead. Retrenchment has been a necessary measure, though a cruelly hard one, but taken by itself it is not enough. The digging of a hole and crawling into it is not the road to salvation. Some positive innovations are required.

There need be no mystery about them. The first thing needed is to put costs and charges in proper relation to each other.

Airports need rational rate scales and proper cooperation between commercial and municipal fields. It is of the first importance that nothing should be done to hamper airport development, and that municipal governments should cooperate with the commercial operator to the limit. Too often he has been treated as though he were a hated interloper. Airports must be recognized as public utilities deserving public support, not as emotional adventures. Every community needs aviation, and the community must provide the facilities on reasonable terms. If the work is done by a commercial organization, it must be recognized on a parity with other public utilities, entitled to special consideration and assistance from state and municipal governments, and subject to some regulation by them.

We need a clarified legal position. So long as the decision of Justice Hahn hangs like a sword of Damocles over the head of the airplane industry, neither airport owners nor operators can be on a sure footing. Aviation will advance with trembling and uncertain steps till these questions of trespass, of inherent nuisance and of limiting altitude of flight are cleared up.

We need a clearer understanding of our relations with the Federal government, and a better appreciation in Congress of where aviation is going and how. Liberal appropriations for the support of air transport are required now. There should not be the slightest thought that they involve a permanent subsidy. An addition of a million dollars on the air mail appropriation for the coming fiscal year will be ten times as valuable as a corresponding addition ten years hence.

We need intelligent thought on aviation as a sport and on the position of the private owner. We need the development of flying clubs, and of competitions especially directed to the interest of the non professional pilot. We need research addressed particularly to the private owner's needs and to the production of an airplane that

will be easier for him to fly than the existing types Both for the private pilot and for the commercial voyager by air on irregular itineraries better service at airports and better transportation facilities are urgently required A great proportion of American airports are still eyesores, and the complete failure in four cases out of five to make provision in advance for quickly and efficiently meeting the demands of incoming voyagers is a perfect disgrace

Part of this program is obvious Part of it is not Some of it will be unanimously accepted Upon other features dissent is possible But there are two points which apply to the program as a whole and which should be emphasized to the limit

In the first place, there is no anticipation of technical miracles We have been too prone in the past to talk about the wonderful progress that was being made, and about the marvelous accomplishments that would characterize the airplane of the next year or five years hence *If* it proves possible through the initiative of the engineer and inventor to produce planes with twenty miles more high speed and twenty miles less landing speed than in the past, with double the payload and half the maintenance expense, or to fly regularly through the densest fog, we shall be duly appreciative, but we should be badly advised to hang the future of our industry upon such unpredictable developments

Secondly, there is no talk here, and let us have none elsewhere, of arbitrary subsidy of the whole aircraft industry by the Federal government Aviation needs certain measures of support from Washington and from the state capitols, but the talk of direct subsidy of plane manufacture or of private ownership, or of the assumption of enormous responsibility by the Federal government for local airport construction, is silly and time wasting Our present situation is our own problem, and we shall have to work out of it by ourselves with governmental activity confined within well-defined boundaries and Federal funds expended primarily in directions which naturally and closely relate to activities already undertaken by the executive departments We can find a path which leads upward even though the climb be but slow, but we cannot make a safe ascent onto higher levels through slothful dependence on the provision of some sort of an industrial elevator by a prodigally paternalistic government

BREAKING THE VICIOUS CIRCLE

ONE hears a great deal about 'the used plane problem" from the new plane dealer whose chief immediate interest is in the sale of new equipment Naturally the dealer would make more money on each individual sale if he did not have to fuss around with a trade-in The same thing is true of the automobile industry, and there have been weepings and wailings for many years now over the used-car incubus

The larger aspects of the problem of popularizing a new mode of personal transportation, such as the automobile was and the airplane is, put an entirely different face on the "trade-in." The re-sale of automobiles as second-hand equipment, to people who could not afford to buy the new, has been a major factor in popularizing the motor car Even now, the typical first-time purchaser of a car starts with a used machine and later graduates to a new model The forcing out on the market of used automobiles at constantly lower prices has step by step carried the market for automobiles down through the various price ranges to constantly enlarged groups of purchasers, until now there is hardly a high-school boy who cannot have his "flivver"

The same situation is apparent in the airplane market Where a year ago or two ago the airplane as a means of personal transportation was a luxury to be thought of by the wealthy only, the re-sale of used and re-conditioned equipment has already brought the closed-cabin airplane within the reach of the pocketbook of the man in the street With the price barrier lowered, the possibilities of sales have been greatly expanded In California there are several firms which have made a handsome profit during the past year by specializing in the re-conditioning and re-sale, at a very reasonable price, of used airplanes A sale made at a thousand dollars takes nothing away from the dealer in new machines at five times that price or more, for the purchaser of a used plane is ordinarily choosing between that and nothing

The vigorous promotion of the use of used airplanes increases the amount of flying done, creates new prospects for new sales causes the establishment of improved and expanded servicing facilities, and helps to break the vicious circle of low production and high prices

Such a doctrine is not immediately apparent in this period of business depression, during which the top of the market has been stifled by a general recession in new and unusual expenditures In the meantime we are faced with real opportunities to broaden the present airplane market through an active policy of re-conditioning and re-selling wherever possible. It goes without saying that reconditioning is necessary, and that the dealer who sells a used plane must feel a certain responsibility to the purchaser for its condition On the other hand, no stigma need attach to the words "second-hand The used plane can be a credit to its original maker and to its owner

The policy of keeping every airplane in the air as much as possible, instead of permitting idle planes to rot in the hangars, will bring results in new-plane sales The so-called "used plane problem" if properly treated is one of the industry's greatest opportunities to popularize private use

ENOUGH OF EXHIBITION

ANOTHER "National Air Race" meet has receded in the distance We have made comment elsewhere upon the management, which was in many respects irreproachable and deserving of the highest commendation The criticism that we have to press is not of any detail of organization, nor of those charged with the execution of the general plan It bears against the general plan itself and against the whole trend of "Race" development

For eight years there has been a steady drift away from the original purpose and plan of these events The departure from the old and seemingly outworn idea that the Air Races should be offered simply as races, and that an intelligently interested public would be drawn out to attend the competitions has reached a climax at Cleveland last year and at Chicago this summer It is our earnest hope, and from the comment that we have heard from leaders of the industry and others the hope may well be justified, that the spectacle accorded there will never be repeated.

At Detroit in 1922, two days were given over to competitions run off in rapid succession There was no attempt to attract the entire population of the city of Detroit to the field, but there was a good attendance of those who knew something about flying and wanted to see how the planes would handle when pitted against each other Commercial aviation was practically nonexistent and the military had to provide almost all the entries, but still the events were interesting and well run

In eight years the two days have been stretched out to three, to four, and finally to ten The number of races has been increased, but their relative importance on the program has steadily diminished. So far as the crowd is concerned, they have become, with the exception of one or two particularly exciting events entirely negligible Great throngs are drawn to a field to see exhibitions of stunting So far as they are concerned the races are merely an annoying interlude and they would come just as readily if there were to be no competitions at all The National Air Races in short which were to have been the testing ground for new airplanes and the aeronautical engineer's spur to achievement, have become merely a peg upon which to hang a request for and an excuse for securing, the participation of the Army and Navy and civilian stunting teams

In the long run that does not, and cannot, do aviation any lasting good Admittedly, a certain number of people are impressed with the strength and controllability of craft that can be driven through such fantastic evolutions and are inspired to take a ride themselves as a result In AVIATION for October Mr McReynolds as the result of a careful study, put the case very strongly for the good that stunting shows may do along that line Many, however, plan for only a single trial hop, and air transport cannot subsist upon that sort of business The sub-conscious effect of the display upon the public, incapable of appreciating the fine points, is, we are sure, definitely bad An afternoon at Curtiss-Reynolds Field during the race week could not fail to imbue the casual onlooker with the conviction that airplanes were stunt vehicles flown by wild men He may not realize the fact himself, but when the opportunity of using air transport offers the recollection of Doret and Atcherley and Lund and their skillful rivals will rise up in the back of his mind to suggest that the airplane has nothing in common with railroads and motor buses and other sensible means of getting from place to place

Whatever differences of opinion there may be upon the effect of stunting on the spectators at the field, there can be no question about what it does to the newspaper-readers Eight hundred miles from Chicago the air races were still a front-page story, and "Amazing stunt flying" and "fatal crash" chased each other in and out of the head-lines Aviation could have had no worse publicity than that given by the typical press story on three or four of the ten days of the meet

We speak with the more emphasis on this theme because of conviction that the acrobatic element could be greatly subdued without by any means destroying the meet as a public attraction Innovations made in the conduct of the races this year, greatly to the credit of the management, made them potentially far more exciting than in the past without in any way being more dangerous, except when the small course was used for high-powered planes of the very highest speed The simultaneous standing start has made a race out of what used to be a parade. The introduction of handicap events, on the lines used so successfully in England, will be another great step in advance Given a further study of the problem, and especially much further improvement of the facilities for keeping the audience informed on what is going on at every instant, we believe that the races can be made to stand alone and draw a very satisfactory crowd.

After the Cleveland meet we expressed our violent distaste for stunting exhibitions by civilians in civil airplanes There was both agreement and disagreement, some of it violent, from within the industry We believe we are sure,—that stunting has many fewer friends now than it had in 1929 For ourselves we go farther than we did then We oppose not only civilian stunting exhibitions but all stunting exhibitions, by whomsoever given or under whatsoever auspices, except as a part of a purely military pageant, organized by or for the military services alone for the purpose of displaying the equipment and tactics that they might have to employ in war

Unless the National Air Races can be put on a new basis and headed back towards their original aim they had better be abandoned entirely,—or if they are to survive, let them remain frankly in the hands of the showman and abandon the pretext that they have an inherent right to loyal support from the aircraft industry

A CONFERENCE THAT GOT RESULTS

THE recent meeting between the representatives of the aircraft industry and those of the Department of Commerce had several claims to distinction It was the first gathering of the kind for which there had been any really thorough preparation among the industry's representatives It was the first that had been held in a sufficiently calm atmosphere to permit concentration upon the business in hand. Aloof from the shouting and the tumult of races or shows, in the face of a diligent advance circulation of intangible rumors that the participants were "going to the mat" or that they would "make outspoken protest against the whole trend of Department policy," the affair proved to be marked by harmony and mutual sympathy beyond all precedent It was, in short and without qualification, the best and most intelligent and most business-like and most helpful meeting of the sort in the four years of the Aeronautics Branch's history

It was encouraging that the Department and the manufacturers were able to agree without hesitation on a majority of the propositions advanced, and even more encouraging that Secretary Young and his associates were willing to give the most sympathetic consideration to any proposal made and the reasons for making it, no matter how far out of line with current policy and the presumed personal views of the Department's officials it might be When the case had been presented, and talked out in detail, there remained real differences of opinion upon only four points of major importance,—spinning, performance requirements, the use of centralized testing stations, and the status of the student pilot

On those four points we find ourselves clearly in sympathy with the industry's views on one, somewhat upon the fence on two, very emphatically in accord with the Department's position on the fourth

I. We believe, as the industry is apparently almost unanimous in believing, that detailed minimum specifications of performance as a prerequisite for an approved type certificate are out of place The reasons offered by the industry's representatives in discussion are valid Airplanes are being built now, and will continue to be built, to meet special operating problems No set of specifications can make a machine aerodynamically safe under all conditions Performance needs vary so widely that the only possible measure for the Department is to assist the purchaser in getting full and accurate information upon the relative capacities of the machines that he is considering, and then,—let the buyer guard his own interest

II. With the view that there must be relaxation in student permit requirements we are in full accord. That the owner of an airplane should have to go and have a physical examination before handling the dual control in his own machine, or that a sportsman owner should be unable to initiate his friends into the kindergarten stage of piloting in his own ship, is an absurdity. It is a deterrent to private ownership, for it destroys one of the attractions of flying Admittedly, the Department's position that miscellaneous joy-riders on their first hop must not be permitted to play with the controls is perfectly sound Safeguard against that possibility must be provided The present rule goes much too far, and some sort of a legal dodge can be found for improving the situation without introducing new dangers

III. The spinning rules are hardy perennials They automatically re-appear at every conference A great amount of dissatisfaction, much of it rather vague in nature, is expressed, and the meeting adjourns with no changes made. This year the industry brought forth certain specific proposals They represent a move in the right direction,—to throw more emphasis on the difficulty of getting into a spin, and not so much on the ease of getting out of a long-continued one, but they go too far If the views presented to the Department of Commerce on behalf of the manufacturers were accepted in toto, machines with inherent spinning dangers would become eligible for A.T.C.'s What we want is not merely an airplane that does not go into a spin from sheer malevolence, with controls still neutral, but one that cannot be spun at all or can be spun only with the greatest difficulty The industry's recommendation provides a hint which we earnestly hope the Department may take, but it does not provide a verbally acceptable text

IV Finally we come to the point at which we align ourselves solidly with the Department. There was an astonishingly intense opposition to the proposal that all flight tests of new planes should be made at one of eight prominently established testing stations Admittedly, difficulties would arise for some manufacturers. There would be occasional delays and expenses, but the advantages of working with a permanent and competent organization and of working at stations where proper instrumental equipment for making complete measurements of performance and flying characteristics can be assembled and permanently retained far outweigh the drawbacks

We very earnestly hope that the plan will be put into affect at least provisionally, even though it be tried at first for only one or two selected areas, and that the industry will loyally cooperate in trying it out If that be done, we are sure as we can be of anything that time will prove most of the supposed dangers to have been illusory, and that within a year the manufacturers as a whole could not be driven to re-adopt the present plan

The relations of the government with the business will enter the new year with a very nearly clean slate. Of the innumerable topics presented this year, only two or three or a half a dozen at most will still be live issues when the next conference is called Nineteen thirty-one will have to develop its own regulatory problems and its own proposals for revision of the Air Commerce rules and their appendices

The Trend of Activities

BY R. SIDNEY BOWEN, JR.

THE NEW COAST-TO-COAST LINE

WHILE aeronautic merchandizing in general appears to be marking time air transport development continues The publishing date of this issue marks the inauguration of the first New York-California air mail and passenger service T A T Maddux and Western Air Express having been awarded as the result of a joint bid the central transcontinental air mail contract, and having merged together as one operating company under the name of Transcontinental & Western Air Inc., will, beginning with November 1, fly passengers and mail from Newark Airport to Los Angeles in about 36 hours Although this is not the first coast to coast all-the-way by air service, it is the first which will start from the City of New York and go straight across the country to the Pacific Coast The route as planned will be over one half of the old T A T route and half over the old Western Air Express route

For the purposes of review, it might be stated that the original plan of the company was to fly passenger ships carrying mail only, from Newark Airport to Columbus, Ohio, for a practice period of 15 days beginning October 15 Passengers were only to be flown west from Columbus However, it was later decided that the Newark-Columbus division would not be opened until the combined air mail and passenger service was available. Therefore, the fifteen day period was devoted to trial trips over the Newark-Columbus route with the planes carrying only the pilots and Company personnel

Ever since the 1927 boom in aviation the public at large, and particularly New Yorkers have been waiting for a direct coast to coast passenger service At regular intervals there have been most persistant rumors floating about to the effect that such a service was soon to be announced Those who understood the situation knew that the stumbling block, or rather, the barrier to such an airline was the Allegheny Mountain range They also knew that considerable experience in air transport operation was necessary before a line crossing the Alleghenies was inaugurated. With the possible exception of one or two air transport companies, T A T, Maddux and Western Air Express have had more actual experience in hauling passengers over great distances than any other air organization in the country

Therefore, we need not regard this new coast to coast, all plane service as being a possible example of too rapid development in the air transport field The merger of T A T-Maddux and Western Air Express brought together three successful air transport operating companies The success of an air transport company is dependent upon its operating personnel It therefore, follows that the combining of three groups of men into one group will make that one group just that much stronger than any one of the individual groups Of course it could also be said that merging often results in too many cooks spoiling the broth Yet we do not feel that the old adage applies in this particular case

There is every reason to believe that traffic on the new line will be most encouraging right from the very start However it is quite possible that through traffic will decrease somewhat after the line has been operating for a few months The loss of that type of traffic, though, will be more than made up for with between-station traffic

Our reason for stating that through traffic will drop off in a few months is because we do not believe that the average traveler is going to seriously consider flying twelve hours a day for two days in succession. At least, not after he has once done it. And not unless he is in very much of a hurry Railroad men tell us that in proportion to the number of people who travel by train from New York to California, the number who ride straight through is very small indeed Regardless of the great time saving afforded by the use of the airplane we still believe that the majority of coast to coast airline travelers will do their traveling in easy stages and not in one or two long jumps

THE 1931 DETROIT SHOW

THE announcement that Detroit is to be the scene of the 1931 International Aircraft Show will undoubtedly be well received in many quarters For the last two years the subject of aircraft shows has been discussed more than any other single aeronautical subject The chief complaint has been that aircraft shows have been far too numerous Another has been that there has not been a sufficient lapse of time between shows In one or two instances it was a case of dismantling an exhibit and shipping it overland for speedy assembly at another show in another city To fulfill both engagements meant that officials of the company had to be away from the factory for almost a month The result was that the expense was far greater than the benefit derived from the two exhibitions. Still another complaint has been that the shows were held at the wrong time of the year

Regardless of the sincere attempts on the part of the Aeronautical Chamber of Commerce (which is composed of, and governed by, members of the industry) to straighten out the aircraft show situation no great amount of success resulted Several independent promoters put on shows throughout the country and although they were not sanctioned by the Chamber, they were attended by members of the industry, many of whom were exhibitors And in some cases manufacturers exhibited by the proxy method

Shows came and went, many of them complete financial failures to the sponsors, and most of them a loss of time and money to the exhibitors However

there is one exception that stands out That exception is the All-American Aircraft Show which has been held in Detroit every year since 1928 The Detroit Show which until this year never had anything but a Class B rating has been the outstanding show each year with the possible exception of the Chicago Show in December, 1928

There are many who wonder at the success of the efforts of the Detroit Board of Commerce The reasons for Detroit's success in aircraft shows are not particularly difficult to ascertain To begin with, Detroit is what we like to term as an airminded city It is also a mechanical city And last, but by no means least, the Detroit Show Committee strives to put on a show that is not only bigger and better than the preceding one, but a show which offers increased possibilities to the exhibitor

In a Detroit show one views only aeronautical products There are not a hundred odd products on exhibit that have nothing to do with airplanes Then too the decorations at a Detroit show are just enough to dress up the exhibiting hall and give the place a convention atmosphere The Detroit Show Committee does not have to depend upon trick decorations, side shows and ballets to get the public by the gates

All of which is not simply praise of the Detroit Board of Commerce and local aeronautical enthusiasts, but a few facts from which can be derived the reasons why the Detroit Show has been and still is the most successful and popular aircraft exhibit of the year

We might say that when Detroit starts to swing an aircraft show it follows through with the swing Unfortunately, as exemplified by this year's Detroit affair the exhibitors do not follow through. That, however, is not the fault of Detroit and its board of commerce It is the fault of the individual exhibitor

Therefore, the 1931 Detroit show, which is to be the Class A show of the year, rightly demands the concentrated attention of every potential exhibitor, as well as all who plan to attend and inspect.

We make no prediction about the forthcoming Detroit exhibit, but we believe that it will be a show that will offer even greater possibilities to the exhibitors than ever before. In what manner the possibilities can be turned into absolute actualities will depend upon the exhibitor. Detroit can put on a good show, but it can not make that show a success for the exhibitors unless the exhibitors themselves do something about it

They didn't do anything about it last April and consequently the show was a failure from the standpoint of the exhibitors. That, however, is history and there is nothing to be gained by weeping over spilt cream. What the exhibitors should do is to profit by the lessons they have learned

The first is that the day of an aircraft show being an excuse for old timers to get together for a series of hotel room celebrations has gone forever. The aircraft industry has very little to celebrate just at present Another lesson is that the mere exhibiting of a plane will not sell it to a prospect. The prospect must be also sold by word of mouth Still another is that airplanes roped off from close inspection, and guarded by salesmen who practically growl at whosoever dares to so much as stick a finger across the "dead line," give the possible prospect the impression that the planes are very frail and easily damaged In addition, the actions of the salesmen add a few more stones to the wall of sales resistance

Much as we would like to think otherwise the next two years are going to be rather lean ones for aircraft sales The task of the salesman will probably be more difficult than ever before, that is, if it can be more difficult than it is just at present There is a vast amount of ground work to be done. New industry contacts have got to be made. The potential markets have got to be analyzed in great detail In short the selling forces in the industry have more or less got to start from scratch and build up their respective organizations just as though the airplane were being announced to the public for the first time.

It is of course true that in some cases a few of the old contacts established in years past are still good retail outlets for the manufacturer We do not mean to imply that even the skeletoo of an aeronautical selling organization does not exist. Nor do we imply that the selling experience acquired during the last four years is of no benefit to the manufacturer The idea which we are endeavoring to bring out is that manufacturers will probably do better if they look upon 1931 as an altogether new and separate merchandizing task, rather than regard it as a continuation of a task in hand. While the old saying, new brooms sweep clean, really refers to personnel, in this case it can mean new ideas, new thoughts and new plans

If the members of the industry visiting or exhibiting at the Detroit Show next year bear those and other things in mind their chances of deriving maximum benefit from the Show will be tremendously increased That there will be prospective plane owners attending the Show, is a foregone conclusion It is not, however, a foregone conclusion that they will sign on the dotted line at the show That, incidentally, has appeared to be what the majority of show exhibitors expected in the past They wanted cash on the counter Anyone who gave indication of doing it was treated like a king by the visiting salesmen. However, once it became apparent that considerable follow up was necessary the attentiveness of the salesman vanished with extraordinary rapidity An aircraft show is nothing more nor less than an opportunity for the members of the industry to get a first hand look at what competitors and noncompetitors are offering, and to make initial contacts with future customers. The man with a promise or even an evident interest should be entitled to just as much consideration as the man with cash in his hand A visit to any automobile show will prove that idea

As a matter of fact, we suggest, for educational purposes that every member of the industry who intends exhibiting at Detroit visit an automobile show between now and that time, and make an intensive study of how the automotive industry treats all those who visit its shows We feel sure that what is learned can be put to good advantage at Detroit It can be depended upon that the Detroit Board of Commerce will offer increased opportunities at the 1931 show It remains for the exhibitors to take full advantage of what is offered

THE FLIGHT OF THE COLUMBIA

FRONT page flights during the last few weeks have consisted of two long distance ventures One by a lighter than-air craft which ended in disaster And the other a North Atlantic trip by a famous airplane The first was of course the R-101 and the second was the Columbia

The flight by Boyd and Conner in the Wright powered Columbia from Harbor Grace, Newfoundland, to the Scilly Islands off the south-west coast of England was not particularly public stirring in view of the fact that way back in 1927 Clarence Chamberlin flew it from Roosevelt Field, Long Island, to Kotbus, Germany Boyd and Conner made a very nice flight and are entitled to congratulations

It is a man who was not aboard the plane who wins our highest praise. That man is G M. Bellanca who designed and supervised the construction of the Columbia in 1926 Since that time Mr Bellanca's plane has attracted the attention of the world on five different occasions True, the first of its many splendid performances in public, the winning of two trophies at the 1926 National Air Races in Philadelphia, did not receive much attention outside of aeronautical circles However, the other flights have been talked about in every civilized country.

In the early spring of 1927 Clarence Chamberlin and Bert Acosta piloted the Columbia to a new world's non-refueling endurance record. In June of that same year Chamberlin and Charles A Levine made their famous trans-Atlantic flight in the Columbia In June of this year Roger Q Williams, Capt J Errol Boyd and Lieut Harry P Conner took the Columbia on a non-stop round trip flight from New York to Bermuda And only a couple of weeks or so ago, Boyd and Conner flew it across the North Atlantic for the second time

No other plane ever built, with the possible exception of the Southern Cross, has a flight history comparable to that of the Columbia. And what is perhaps even more astounding is the fact that the same 225 hp Wright Whirlwind engine has done every job.

While it is perhaps best for a product to be known by the name of the company which manufactures it rather than by the name of its creator, both Charles L Lawrence, designer of the Wright Whirlwind and G M Bellanca, designer of the Columbia should at this time be declared exceptions It is our belief that aviation is still enough of an infant to stand individual praise and honorable mention without companies suffering thereby In the past it has seemed to us that the designers of famous airplanes have received a minimum of recognition and reward. In some cases, of course, more than one man was responsible for a design of an aircraft that later became famous

We wager that a good number of the industry would have to think a long time to recall the name of the man who designed The Yankee Doodle, the City of New York, and many others, even the Spirit of St Louis. No matter how good a pilot may be, his ultimate success depends upon a good airplane and a good engine Somehow we can not help but feel that more recognition of the men who help in such a material way to make it possible for pilots to become famous would not be hurting anyone else and perhaps would lend incentive to genius

THE R-101 DISASTER

WITH respect to the tragic end of the R-101 there seems little that can be added to what has already appeared in print. An air crash that results in complete loss by fire usually remains somewhat of a mystery as regards the cause or causes of the crash While there were a few who lived through the R 101 disaster they were unfortunately not in a position to note what was taking place before the craft made its fatal plunge The man or men in the control room perished so it will never be known whether disaster was foreseen and the captain and other officers of the ship duly informed of conditions

The only other thing that the crash investigators can go on is the testimony of witnesses And from all accounts the testimony that was available was not of much use There seemed to be considerable difference in the testimony of the various eye witnesses. The altitude of the craft over the spot of its last resting place varies from one hundred to fifteen hundred feet The manner in which the craft struck the ground is not clear to all of the witnesses And no two witness seem to agree on the matter of whether fire broke out while the craft was in the air, when it struck the ground, or after it had settled.

The stories regarding the end of the R-101 are neither surprising nor unusual That is, of course, the stories of witnesses When it comes to telling about an accident that a person has witnessed, it is not at all unusual for that person to speak of things that did not happen at all In some way the imagination plays queer tricks with an accident witness The result is that often the true story is never known

That is what we fear will be the case with reference to the R-101 The effort to determine the cause of the accident was not made with the idea of establishing what members of the ship's personnel were responsible. It was to determine what happened so that precautionary measures could be taken to guard against a recurrence The possibility that cause will be determined seems very slim However, the case will be argued pro and con in England for many months to come

We sincerely hope that official controversy will not result in a total curbing of English development in lighter-than-air craft We hope thet it will only result in progress being made at a less rapid rate No matter how we may have felt before, it is quite evident thet the R-101 started on her last voyage at the wrong time. And when we speak of wrong time we mean before it had been definitely established by research and aeronautical progress in general, that the chances of her reaching her destination were all in her favor It might be argued that they were, yet such argument can not hold much water in the face of the fact that the R-101 was to traverse terrain entirely foreign to lighter than-air operation

An English lighter-than-air critic stated in the House of Commons in March, 1928, that after an expenditure of nearly twelve millions of dollars England has got only 1,040 flying hours out of eight of her ships The cost of each flying hour being the sum of $7,500 It is assumed by many that such a great loss of money and life would not have come to pass had England's ill-fated ships been filled with helium That of course is a matter for conjecture But it is quite possible that the use of helium would have reduced the terrible toll. For that reason the desire on the part of aeronautic heads in this country to have President Hoover exercise his authority in the matter of exporting helium, is well founded It has been stated that had the offer to foreign countries been made a few years ago it probably would have been rejected with thanks But today it is highly possible that the offer would be accepted with thanks.

However, we do not feel that the use of helium is the entire solution of the problem of safe travel by lighter-than-air-craft The complete solution will be found in continued development — continued development that is made not in haste but in easy stages and in keeping with knowledge acquired To go slow is no indication of inability As a matter of fact it is an indication that one is profiting from lessons learned The heavier-than-air groups have got to do the same thing, so the lighter-than air groups will have lots of company

Statistics of the Month

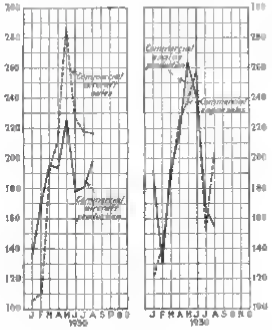
Material supplementing the statistical issue AVIATION, *March 15 1930, appearing regularly each month. Page numbers in the statistical issue are given.*

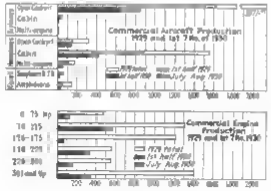
COMMERCIAL AIRCRAFT PRODUCTION AND DISTRIBUTION

(Page 660) As in 1929 the production figures for the first eight months of 1930 show the open cockpit type of biplane leading with 69.3% of the total production. Cabin type monoplanes come next with 33.2% and open cockpit type monoplanes next with 10.3% of the total production leaving a balance of 7.2% divided among the cabin biplanes, multi engined planes, seaplanes, flying boats and amphibians.

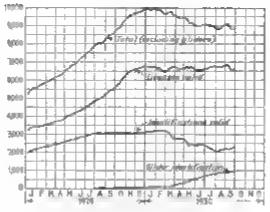
During the first six months of 1929 there were 2,864 commercial airplanes produced, while during the first six months of 1930 1,838 planes were reported. Production during the first half of 1930, therefore, was 64% of the 1929 figure.

As to engine production, the total productions for the first half of 1929 was 2,270 commercial engines while for the first half of 1930 it was 1,233 engines or 27.8% of the 1929 figure.





The top graph shows a comparison between aircraft production for the first half of 1928, the total for 1928 and total production for the first seven months of 1930. The lower graph shows engine production for the entire year of 1929 and for the first seven months of 1930. Due to the fact that available data on engine production during the first half of 1929 was given on a different breakdown basis it is impossible to use these half-year figures for comparison.



Aircraft and glider licenses and identifications

Airplanes	Licensed First Half 1930	Licensed Third Quarter 1930	Total (Nine Months) 1930
Aeromarine Klemm	17	14	51
Aeronca	2	55	53
American Eagle	69	52	121
Arrow	13	9	24
Bird	23	40	63
Boeing	6	5	11
Cessna	16	8	24
Command-Aire	16	16	32
Curtiss Robin	58	37	93
Eaglerock	86	54	140
Fairchild	74	30	104
Fairchild monoplanes	*40*	*8*	*48*
Fairchild KR	*34*	*22*	*56*
Fleet	68	52	120
Fokker	18	4	22
Ford	13	5	20
Great Lakes	44	32	76
Keystone-Loening	17	13	30
Lincoln	38	20	58
Lockheed	17	10	27
Mono Aircraft	73	32	125
Monocoupe	*54*	*18*	*100*
Monosport	*10*	*0*	*05*
Moth	62	9	71
Nicholas Beazley	26	14	40
Parks	6	5	11
Pitcairn	10	3	23
Ryan	55	11	44
Savoia Marchetti	14	8	22
Sikorsky	18	8	26
Spartan	51	2	35
Stearman	28	14	42
Stinson	67	133	222
Swallow	52	12	44
Travel Air	119	80	199
Biplane	*104*	*71*	*176*
Monoplane	*15*	*9*	*24*
Waco	165	199	370
Miscellaneous	252	151	365
Total	1,541	1,155	2,696

LICENSING

(Pages 500 681 and 682) Periodic Airplane License and Identification Data—September 07, 1930

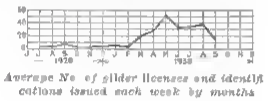
Licenses valid	6 655
Identifications valid	2,238
Total	8,895
Ratio of licenses to total	p 737
Glider licenses and identifications valid	977

Periodic Pilots and Mechanics License Data. September 27, 1930

Airplane pilots licenses valid	14 425
Glider pilots licenses valid	118
Mechanics licenses valid	3,979

New airplane and glider pilots licenses issued during September 2328

Private	526
Industrial	1
Limited commercial	54
Transport	54
Glider	17



Average No. of glider licenses and identifications issued each week by months

Relations of licensed and identified planes, pilots and mechanics September 07, 1930

Ratio of licensed pilots to total planes	1 622
Ratio of licensed mechanics to total planes	1 009

QUARTERLY LICENSE DATA

We presented a tabulation of the makes of aircraft and engines in the planes licensed quarterly during 1928 on page 693 of the March 22 issue. In the September issue of *Aviation*, page 188 we presented a continuation of this tabulation which covered the first two quarters of this year. Herewith are the tabulations for the third quarter of 1930.

The total number of planes licensed during the third quarter has increased 48% over the total for the second quarter of 1930. The five largest manufacturers received approximately 40% of the licenses issued during the first six months of the year and 48% of those for the third quarter.

The ten largest taken together received approximately 80% of all licenses issued during the first six months of 1930 and 73% during the third quarter of the year. However, this slight increase in the percentage of licenses granted to these particular makes of planes will not fully account for the increase in total numbers of licenses granted. The smaller units of the industry are also increasing production to some extent.

As for the power plants used in the planes recently licensed, war surplus engines still account for 37% of the total. Foreign engines account for slightly less than 2%, as compared with 5% for the first half of the year. Of the total number of domestic engines used, five manufacturers account for 80% as compared with 78% for the first half of 1930. Two other makes of engines on which production was started late last year account for an additional 20% of the domestic planes used during the third quarter of 1930, as compared with 12% during the first half of the year.

Engines	Licensed First Half 1930	Licensed Third Quarter 1930	Total (Nine Months) 1930
Aeronca	2	33	37
Axelson	4	9	15
Amaranth-Cirrus	51	56	87
Comet	3	2	3
Curtiss	46	33	79
Hess Warrior	6		6
Kinner	211	149	360
Lambert Velie	93	68	145
Lelbland	64	33	93
Lycoming	63	110	173
P & W Hornet	29	11	40
P & W Wasp	80	56	136
Wright Cyclone	4	1	5
Wright Gipsy	15	4	17
Wright Whirlwinds	290	121	411
Warner	54	122	176
Miscellaneous	11	20	31
U.S. Surplus Engines			
Hisso	53	19	72
Liberty	1	5	4
OX5	573	258	651
OXX6	20	30	50
Foreign Engines			
DH Gipsy	51	6	57
Siemens Halske	6	2	8
Walters	3		3
Miscellaneous	18	15	51
Total	1 541	1 135	2,696

AIRPORTS

(Page 382)

	Airport Statement Jan. 1	Aug. 1	Sept. 1
Municipal airports	455	506	515
Commercial airports	493	360	572
Intermediate fields	285	508	318
Auxiliary fields	255	217	285
Government fields	84	80	70
Total	1 552	1 671	1 764

AIR TRANSPORT AND MAIL

(Page 674) Airway and Operation Mileage September 20, 1930

Miles of mail airways	32,011
Total miles of airways	34 371
Miles scheduled daily with mails	30 834
Total miles scheduled daily	126,714

(Pages 676 & 7) The table of June air mail operations appeared on page 18 of the September 27 issue of *The Aviation News*. Cumulative totals for the first seven months of 1930 are

Total miles scheduled	9 619 530
Total miles flown	9 021 083
Pounds mail carried	4 453 957
Amount paid to contractors	$0 172,397
Average weight per scheduled trip lb	296
Average compensation per mile/down	$0 906
Average compensation per lb carried	$1 834

(Page 576) Contract air mail regularly (Percentage mileage flown is of mileage scheduled)

July	99 5%

(Page 578) Percentage of total route mileage on which mail is carried.

September 1930	38 8%

AIR MAIL POUNDAGE

Can	Route	Operator	1927	1928	1929	(First Seven Months) 1930
1	Boston-New York	Colonial	20 186	35 743	116,093	70 694
2	Chicago-St. Louis	Universal	34 794	63 489	78,077	32,584
3	Chicago-Dallas	National	109 789	226 836	391,497	243 127
4	Salt Lake City-Los Angeles	Western	203 224	383 923	732,683	489 562
5	Salt Lake City-Pasco	Varney	59 972	155 567	236 083	161 831
6	Detroit-Cleveland	Stout	1 724	1 170		
7	Detroit-Chicago	Stout	12,291	9 758		
8	Seattle-Los Angeles	Pacific	113 086	157 664	253 437	149 179
9	Chicago-Minneapolis	Northwest	27 647	71 970	179,376	128,568
11	Cleveland-Pittsburgh	Ball	19 373	66,017	97 027	35 944
12	Cheyenne-Pueblo	Western	36,195	62,817	98 828	49 633
16	Cleveland-Louisville	Universal		28 285	95 840	45,828
17	New York-Chicago	National	172 851	900 441	1 618,287	961 863
18	Chicago-San Francisco	Boeing	286,712	986,164	1 792,506	1 093 600
19	New York-Atlanta	Pitcairn		106 630	341 598	252,994
20	Cleveland-Albany	Colonial Western		52,986	193,983	32,878
21	Dallas-Galveston	Southern A. T.	529	29 195	45 394	21,476
22	Dallas-Laredo	Southern A. T.		42,842	85 671	50,650
23	Atlanta-New Orleans	Southern A. T.		27 677	86 610	62,648
24	Chicago-Cincinnati	Embry-Riddle	1 043	41 098	79 304	41 679
25	Atlanta-Miami	Pitcairn		4 641	121 333	103,142
26	Great Falls-Salt Lake City	National Parks		23 076	69 373	36 641
27	Bay City-Chicago	Thompson		70 166	173,252	105 995
28	St. Louis-Omaha	Universal			63 279	99 189
29	New Orleans-Houston	Southern A. T.			42,146	29,668
30	Atlanta-Chicago	Interstate		8 838	96 067	60 764
31	Chicago-Grand Park Rapids	Curtiss			19 328	
32	Pasco-Seattle	Varney			52,909	33,028
Total			1 131 414	3,544 909	7,100 927	4,455,957

AVERAGE REVENUE PER MILE

Can	Route	Operator	1927	1928	1929	(First Seven Months) 1930
1	Boston-New York	Colonial	$0 62	$1 68	$2 95	$1 65
2	Chicago-St. Louis	Universal	64	1 09	62	49*
3	Chicago-Dallas	National	49	68	1 91	90*
4	Salt Lake City-Los Angeles	Western	1 44	2 33	5 17	2 24*
5	Salt Lake City-Pasco	Varney	56	1 06	1 32	1 03*
6	Detroit-Cleveland	Stout	04	03		
7	Detroit-Chicago	Stout	09	15		
8	Seattle-Los Angeles	Pacific	36	62	95	89
9	Chicago-Minneapolis	Northwest	41	81	71	64
11	Cleveland-Pittsburgh	Ball	99	2 20	2 07	1 06
12	Cheyenne-Pueblo	Western	74	36	34	51
16	Cleveland-Louisville	Universal		34	48	37
17	New York-Chicago	National	68	07	1 14	1 18
18	Chicago-San Francisco	Boeing	80	1 25	1 41	1 45
19	New York-Atlanta	Pitcairn		1 06	1 83	1 30
20	Cleveland-Albany	Colonial Western		55	38	28
21	Dallas-Galveston	Southern A. T.	12	42	37	46
22	Dallas-Laredo	Southern A. T.		50	66	68
23	Atlanta-New Orleans	Southern A. T.		25	47	55
24	Chicago-Cincinnati	Embry-Riddle	25	54	54	29
25	Atlanta-Miami	Pitcairn		21	59	42
26	Great Falls-Salt Lake City	National Parks		41	42	33
27	Bay City-Chicago	Thompson		41	31	26
28	St. Louis-Omaha	Universal			21	24
29	New Orleans-Houston	Southern A. T.			21	22
30	Atlanta-Chicago	Interstate		13	15	14
31	Chicago-Grand Park Rapids	Curtiss			1 64	
32	Pasco-Seattle	Varney			58	84**
Total			$0 67	$0 75	$1 06	$0 84

*Revenue reduced to the last few months as a result of having come under the new Watres Act scale of compensation.

**Operating as a separate line only during first four months of 1930.

AVERAGE REVENUE PER MILE RECEIVED BY HOLDING COMPANIES

Holding Company	Number of Routes	Mileage Flown 1929	Mileage Flown 1930 (First Seven Months)	Revenue per Mile 1929	Revenue per Mile 1930 (First Seven Months)
Aviation Corp.	11	3,329 606	2 181 645	$0 48	$0 41
United Aircraft & Transport Inc.	6	6,156 612	4 122,143	1 24	1 11
Western Air Express, Inc.	2	870 092	577 699	2 71	2 00

Each company is credited throughout the entire period of the tabulation with all lines now controlled by it, even though they may only have been very recently acquired.

THE FUTURE OF AIR NAVIGATION

By Capt. Frank T. Courtney

A critical presentation of air transport problems by a famous pilot, and some novel suggestions as to how they should be solved

SIX years ago I had the opportunity of reading a paper on this subject before the Royal Aeronautical Society. It appeared to attract some little attention at the time, and I have been asked to elaborate some of the points then raised, and bring them in line with the extensive developments which have since occurred.

In point of fact, more recent developments have only served to confirm my original impressions of this subject. While public acquaintance with aviation as a whole has enormously developed in recent years, I still feel that in the actual reliable use of aircraft we have advanced in quantity only and not in quality. In other words, I feel that, while we use far more and better aircraft, we do not use them much better than we did many years ago.

The future of air navigation is far from being a mere matter of speculative interest. It is a subject involving the whole future of almost every branch and aspect of the industry.

The process of evolution through which air transportation must go can be logically worked out and made fairly clear. What does not seem to be clear is that a highly disturbing outlook presents itself if present lines of development continue. Present methods consist of solving, as easily and rapidly as possible, immediate problems as they turn up, without any reference to the effect of these solutions on the ultimate state of affairs.

It sounds somewhat absurd to suggest that some of the most cherished of current "improvements" in aircraft operation, such as the two-way radio telephone, the radio beacon system, airway lighting, many recent flying regulations and, in fact, a large number of the recent developments in Air Mail operations, are mere palliatives for our present difficulties and no real advance.

Yet I believe that to be actually the case, and I will try and prove my contentions.

Let us, therefore, try and get down to simple facts.

Air travel is in its infancy. Like all infants it gets a lot of attention and makes a lot of noise and costs a lot of money. If we try to pretend that the infant is really grown up and treat it accordingly, we are likely to let it wander into all kinds of a mess.

Over our air routes, one or two planes fly each way per day, or grope through by night, landing or being left by parachute when they cannot get through weather which lets by the train and boat. This isn't transportation at all.

I picture air transportation as it must become if all our construction work is to go for anything at all: dozens of aircraft of all sizes and speeds over every line that can be drawn to connect centers of civilization, flying regularly and reliably in any weather that does not stop surface transportation, and a lot of weather that does. We have to come to that. It is no use telling a passenger, who has been landed for "bad weather" and has missed a train that would have got him there, to be Air-minded. Air-mindedness must be suppressed so as we can see air-transportation for merely what it is: a means of transportation *faster* than the others, not merely faster when it happens to work. If we can see that we can commence to see just what are the real problems the future has to face.

WE begin to see that flying in the future cannot be a free-for-all business. All flying, private, commercial and military, will have to be controlled, nationally and internationally, under a highly organized system, and for a very simple reason.

Aircraft absolutely must, and certainly will, be able to operate in any weather that surface transportation can face. This means that blind flying will be the condition under which aircraft will operate much of their time, and on which aircraft operation will have to be based. This in turn means that the greatest danger of the future of flying, collision, so little considered in our present deserted skies, will become the major problem—a problem no smaller and possibly much greater than any we now have to face, a problem which becomes increasingly large as our other problems get smaller.

Capt. Frank T. Courtney, famous British test pilot who during the last two years has been associated with prominent American aviation companies

And a word about collisions: If a rowboat is rash enough to run into the Leviathan it is just too bad for the rowboat. But if the smallest and the largest airplanes collide effectively, both are complete wrecks, and the humor of the situation is lost.

Wherever I look, I cannot see that any line of development in navigation is of any use today unless it leads, gradually as it must, to the solution of that main problem of the future traffic of the skies.

Blind flying, when I first started on this subject, was classed amongst the vaguely desirable stunts. Now it is accepted as being highly important, but its application is still in the vague stage. For there are two main schools of thought on the subject of blind flying. One school greatly augmented by recent air-line accidents, says that air transportation has not reached the stage where we should expect it to get through any weather, that we should make for safety by landing for bad weather, using blind flying merely as an emergency safety device. The second school is typified by the Guggenheim Foundation whose work, as demonstrated by the completely blind flights of Lieutenant Doolittle, shows that aircraft *can* operate entirely without visibility from the takeoff to the landing, although this has so far been done only under specialized test conditions.

But these are two extremes of theory between which the practical working problem gets lost. For the theory of the first school gives up all hope of competitive air transportation pending the perfecting of the work of the second school, and the latter seems to set too high a mark to aim at just now.

The criterion for air transportation is that it shall be able to operate whenever surface transport can operate. This, therefore, does not demand that aircraft must be able to land and take off entirely blind, for boats and trains cannot operate without surface visibility. It does mean that aircraft should be able to operate entirely blind, excepting for the actual landing and takeoff, and with visibility of only a hundred yards or so then. This consideration provides a definite picture of the type of weather which can be made the basis of study, weather where ceiling is so low that, in effect, there exists surface visibility only, so that aircraft cannot now operate, while boats and trains are almost unhindered.

That is the practical statement of the blind-flying problem.

Yet we go on lighting air routes, although the problem is to navigate when lights cannot be seen. (As an old mail pilot recently said to me, "If you can see lights it shows you don't want them; if you can't it shows you do.") We erect a radio-beacon system which forms a species of aerial street-car line positively clamoring for collisions, we fit the pilot's overburdened head with a telephone which he can use least effectively when he most needs it: in emergency.

THE best way to talk about all this is to refer to the Air Mail, wherein it certainly appears to me that evolution has somehow run off the track.

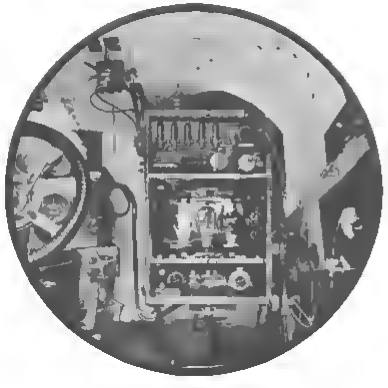
The U S A is proud of its Air Mail system, and certainly wonderful results have been achieved in getting the mail through. The record of the Air Mail is a record of the skill, courage and devotion to duty of the Air Mail pilots—a fact continually referred to in speech and writ-

The Dornier-Napier flyingboat in which Captain Courtney attempted to span the Atlantic in 1928

ing and a fact which shows there is something wrong with the whole business For it shows that the present system rests entirely on the skill and courage of the Air Mail pilot, a sort of soldier always on active service against the elements, who leaves with one motor and no assistance but his own skill and luck, to get his mail to the other end, or jump out with a parachute, or to crash to death against some unseen hillside Even his planes are designed with the crash uppermost in mind, he insists on sitting well back rather than in front where he can see better. I contend that the airway lighting, the radio beacon and the telephone are no real aids to the serious development of navigation, they are merely temporary expedients or lines of least resistance, which put still more up to the *pilot* The radio beacon limits navigation to a single-line track but is the only means of throwing blind navigation on to the *pilot* The telephone is an increasingly inefficient system of aircraft communication, but is the only system that you can clamp on to the head of the *pilot* On the hands and brain of one man everything is thrust all the time And this is not transportation

"But," it is sometimes argued, "this is really unimportant as regards the mail Naturally we wouldn't carry passengers that way" And that is precisely where the whole mistake lies Nobody has any right to imagine that mail carrying can long be kept distinct from passenger carrying The only excuse at present for an exclusive mail-service is this

Aviation, as I have said, is an infant It must not try and run before it can walk Carrying passengers is



Showing passenger plane installation of the Marconi 150 watt aircraft radio set

running, carrying goods and mail is walking And the legs for running must be developed in the walking [Captain Courtney had completed this manuscript before the Post Office Department regulations requiring a combination of mail and passenger service were announced—Ed.]

Having tried to explain how I see the present situation, I will now try to indicate my ideas of firstly what the future situation must be, secondly how it will be solved and thirdly the methods of gradually and effectively reaching the solution

Planes of all sizes and purposes will be flying in all sorts of weather, passing, overtaking and crossing each other at all sorts of speeds Later on, long-distance planes will fly at today's racing speeds far up above the weather and navigating visually, but they will have to come down amongst their blind brethren when near their bases

Imagine seriously your New York Air Terminal of those days It is night, a thin drizzle is falling, visibility is a few hundred feet and ceiling a hundred feet, and our boats and trains are operating to schedule Sixty planes per hour are approaching the city Each plane seeing nothing until the landing lights loom up before it must await its turn to land, be deflected to the particular field best suited to its purpose, and yet stand no risk of colliding with its fellows or with the natural or artificial obstacles surrounding the field

Each plane must have come on its way selecting, not a predetermined route and height (as many would suggest) but a route and height best suited to the efficiency and economy of that voyage. Yet it must have avoided any risk of collision, and must have held itself ready to change its route or height on emergency.

THE only way these results can possibly be arrived at is by the formation of some form of controlling or signaling system somewhat on the principle that exists on railroads To anybody attempting to picture the actual situation it would be obvious that each plane itself would not be able to look after the various factors involved A system which, it seems to me, must inevitably come into operation will be something as follows:

The entire country (and for that matter, the entire world) will be divided up into areas corresponding to signal sections on the railroad Each area will have a central control station which will be most probably situated in the principal airport in that area.

In this control station the movements of every airplane in the area will be accurately followed The degree of accuracy required, and therefore the amount of work involved will obviously depend on the amount of congestion in that area and the current weather conditions The control station will not only follow the routes but will also follow the altitude, intentions and condition of the plane The control station (or signal box) will leave the planes to pursue their own courses normally, issuing instructions as to altitude variation, change of course selection of landing field, etc according to traffic necessities and emergency conditions

The Control Towers to be seen at London, Berlin and other European fields are already the nucleus of such a system. [A beginning of ground control to avoid collisions between planes in free flight has also been made on some American fields, notably on one near Los Angeles—Ed.]

As the plane passes out of that area it will be "handed over" to the control station in the next area with full information as to its course, altitude, etc. In the case of landing in extremely bad weather, the approach to the airport will be governed by instructions from the control station which also would instruct the airplane as to the altitude to maintain whilst awaiting its turn to land, with due provision for emergency

To effect this with accuracy, both plane and control station must collaborate For example the control station must govern a direction finding system wherewith to check repeatedly the position and course of the plane.

This course will be checked and rechecked by a direction finding instrument on the plane itself and by the dead-reckoning calculations of the commander of the plane which will be based on weather and wind information supplied and this dead-reckoning will in turn be checked by the control station. By these means a considerable amount of latitude can be allowed for inaccuracy of instruments and information During a period of prolonged blind flying, obviously a very frequent interchange of signals between ships and control station will be necessary Obviously such work will have to be done as in the case of shipping, in telegraphic code, and it is quite beyond question that the minimum crew will have to consist of one pilot to handle the ship, one commander who will supervise all necessary calculations and communications, and one expert radio operator Radio telegraph requires less power than telephone, is less affected by atmospheric disturbances, and is immeasurably faster when there is a great volume of traffic, as half a dozen letters can be used in code to replace as many sentences

Interior view of an American airline weather broadcasting station

A method of actual approach and landing can be foreseen and need not be elaborated here But it is of interest to consider that, as such blind approach will be governed by radio beam or leader cable systems it is possible that special pilots will eventually be employed for each port or at least for each section connecting two ports, just as they now are for shipping

THE instruments necessary to effect all this are now with us and have been for a long time in various stages of accuracy

Compasses—The compasses of course, are by a long way one of the most important factors My opinion is that the compass situation on most American planes is very unsatisfactory The compass is apparently devised first to suit the plane and secondly to suit the pilot If any qualities are left then the compass can have them The result is that we see such atrocious installations as the fitting of a compass behind the pilot, with figures reversed and reflected, with luck, in a mirror which is, as often as not, misted over and vibrating vigorously Of course, the very best type of compass should be used, preferably one whereon the course figure can be set and forgotten by the pilot It should be as steady as possible It is not too much to suggest that the plane should be designed to fit the compass and the pilot trained to use such a compass in the position where it works best Such compasses exist and have existed for a long time

Blind Flying Instruments—As I have previously said I still think that these have not been studied deeply enough, although all the means are at hand

Analyzed simply, blind flying consists solely in controlling the aircraft in any direction in which the plane will not look after itself Now, that should be a whole lot simpler than it appears This is the explanation:

The airplane has three directions of motion—longitudinal, lateral and directional (pitching, rolling and yawing) Two of these motions are in planes in which gravity operates Thus we employ our old enemy Gravity for both lateral and longitudinal stability Directional (or yawing) motion is not in the direction of gravity and must be dealt with mechanically The characteristics of airplanes are such that variations in directional motion or stability also upset lateral and longitudinal conditions but the plain fact remains that the whole trouble is caused by directional variation

For well-known reasons, the compass cannot help us here and therefore we must use the gyroscope or some such device to help us Hence the turn-indicator

Obviously the automatic pilot, whereby a series of gyros controls the plane, will eventually do all the work in blind flying But at the present stage, for reasons just mentioned, this need only operate the directional control, leaving the careful study of stability to look after the other two controls

Turn Indicators—I assume that we will have to use these for some little while yet I have made a particular study of these instruments and flew with what I think was the first Gyro Turn Indicator ever built, as well as with others which did not operate on the Gyro principle

I consider that the expression "turn and bank" causes some little confusion as the "bank" part of it is of such small importance compared with the "turn" that it ought to be omitted from the description

The difficulty in employing the turn indicator, and therefore the difficulty of modern blind flying results from the fact that the lateral and longitudinal characteristics of the plane are not usually sufficiently good so that the directional control alone can be attended to by the pilot, and therefore the pilot must do very much unnecessary flying work, and his sense of balance is correspondingly upset

Moreover, the ordinary American turn indicator in

rough air requires enormously excessive attention, needing the pilot's entire concentration on the dial of the instrument This is a very dangerous state of affairs since such close attention is mentally extremely fatiguing Turn-indicators exist and can easily be devised whereby the pilot can use them with little concentration and far less fatigue Indication by lights is much less disconcerting than indication by a needle Obviously, the turn indicator, air-speed-indicator and bank-indicator can and should be combined in one instrument.

Radio—Practically all the radio work necessary to carry out the control system already referred to has been in existence for some while Long-range, low-frequency sets have long been used free from ignition interference. The direction finder is still apparently somewhat inaccurate over land but such good work has been done by direction finders on planes that there is no doubt that the inaccuracies are insufficient, when used in conjunction with dead-reckoning and other checking systems, to prevent the blind flying plane from using the direction finder to check its course and position, and to check the approach of a neighboring plane by taking bearings on that plane's signals

A STUDY of these facts makes it clear that no progress will be made by clamping a telephone onto the head of the pilot or co-pilot and leaving him to pursue such course as he can follow with no other object than finding his eventual destination It is clear that the radio would be so fully occupied as to require the constant attention of a very expert operator The commander of the plane will give to and receive from the radio operator all the information necessaary for keeping himself and the control station fully informed as to the progress of the plane He will also decide and work out the course The business of the pilot will be that of actually controlling the ship and following the course indicated to him by the commander

Naturally, in clear weather the business will be greatly simplified, since less exchanging of signals will be necessary between the plane and the ground station

Figures involving the angles of descent and climb for various engine speeds, combined with drift near the ground, will have to be made up into tables which will give an additional check on radio and mechanical devices for approach,

TO ARRIVE at the necessary results it is not possible to try and fit experimental apparatus or to try experimental operation in the course of actual commercial flights. It therefore seems to me essential that, just as large engineering works have their own development and experimental section, so all aircraft operating companies should run an experimental system Of course in this work, which would be for the benefit of all, collaborations between the various companies should be devised But it seems to me that characteristics of the routes in operation are sufficiently varied to justify separate experimental programs over most routes

The first stage in the experiments would be to perfect long-distance blind flying and navigation Perfection in this would overcome much of the trouble now caused in transportation by such stretches as the Pennsylvania Mountains In these stretches the intervening territory is frequently considered impassable when landing fields at both ends are open Such practice can be done in any reasonably good weather, and not merely in the bad weather which it intends to defeat

The next stage is to carry out approach to the fields up to as close a point as possible before the actual landing This stage, of course, will involve many complications and will be a question of degree

Throughout all this flying the best application of the radio will be studied and developed

The experimental plane should carry at least two pilots of experience and one expert radio operator At least two direction finding stations should be installed on the route and a direction-finding installation should be on the plane.

The plane (and there are suitable planes available) should be one which can remain comfortably in the air with its experimental equipment with at least 50% of its power gone

By gradual stages the experimental planes should evolve systems of cooperation between plane and ground stations, and the sequence should be so devised that they can gradually be applied to the operating planes. I am confident that the problem will, if tackled in this way, reach a solution far sooner than would appear from the apparent complications of the subject

Of course, all of this is going to cost money, but it is absolutely necessary expenditure It seems to me impossible that the present method of operating can take us out of the fog of unreliability which is the principal cause of lack of real speed in air transportation, and the fundamental discouragement to passengers

This money, of course, will have to come from the government This will require some study to discover how mail contracts can so be placed as to encourage or compel the operator to run an experimental system At the present it would not seem to me unreasonable for the existing passenger transportation lines to seek a government subsidy to support experimental work I do not know of any form of subsidy which would be better justified The compensation for both government and operators will be that, with the perfecting of reliability and safety, *all* first-class mail will be sent by air, thus justifying the large mail and passenger plane

It is quite clear, however that such a proposal involves the eventual (and, let us hope, rapid) disappearance of the single-motor, single-pilot mail plane *This will have to go.* Anything tending to keep this type of ship in operation is a backward step in aviation It has done its great work of showing the world what flying can do; it must now give way to the development of reliability and safety

AN INTERESTING aspect of the future of flying, which must be kept in mind, is the effect of the above considerations on private flying If aircraft are to compete with surface transportation, they must be prepared to fly blind for a large part of their time If they fly blind, they risk collisions If they are to avoid the risk of collisions they must be controlled under some such system as I have outlined above Consequently planes not capable of coming within such a control system will obviously not be permitted to fly under blind-flying conditions

Obviously, therefore, the day must arrive when private flying must be very strictly limited to certain conditions and possibly even certain routes Thus for the progress of air transportation, it will be necessary that the private flyer of small planes will have to be decidedly restricted and this is a point which must inevitably have an important effect one day on the whole question of aircraft production

FLIGHT INSTRUCTION AND FLIGHT THEORY

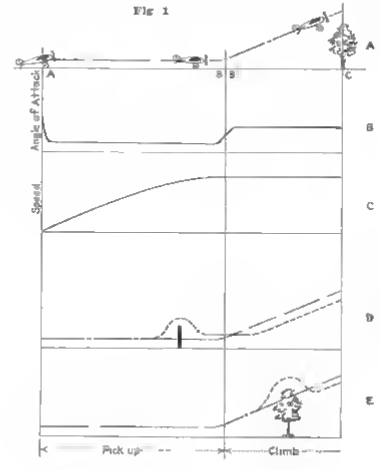
By W. F. Gerhardt

The first of two articles on the advisability of giving the student highly specialized ground instruction as well as actual flight training. Mr. Gerhardt is a well known aeronautical engineer and also a pilot and teacher.

IT IS generally realized that the additional problem of training the operator of the airplane is a serious one, and the public must be taught to fly before the demand for airplanes will be great enough to warrant a continuous expansion of airplane manufacture Although it is hoped that the ideal airplane of the future will be of such a nature as to make extensive training unnecessary, and that such training as is needed can be included in the selling price of the product, for the present the training of pilots is an essential part of the industry

Two methods of flight instruction have been used the all-solo and the dual systems The first was, of necessity, the system used by the pioneers; the second was used extensively during the World War The all-solo method began with the flights of the glider pioneers and, since the recent revival of gliding, is again being considered The system used by the French during the War was the only other important example of an all-solo system of training In the French Air Service the student aviator was more or less his own instructor In practically all other military and commercial flight training the dual system has been used This system has been officially adopted by the Department of Commerce, as set forth in the School Regulations of May 1, 1929, in which a minimum of eight hours dual, and ten hours supervised solo is required for the Private Pilot's License. The main advantage of an all-solo system is the lower cost of the training, as dual time costs fifty per cent more than solo The main disadvantage is the increased risk to the average student The present dual method seems, therefore, to be the most practical, and worth the expenditure of from four to six hundred dollars, which is the cost of a Private Pilot's Course of instruction in an approved school

Fig 1



It is probable that, for the present, reductions in training costs will be effected by reducing the amount of dual time before solo, by the improvement of the flying curriculum, and by the replacement of some of the instruction now given in the air by ground instruction Since instruction in the air costs approximately fifteen times as much as instruction on the ground, the saving is obvious To realize that such procedure is desirable, one must consider the psychology of flying and some of the newly-developed means for the presentation of the theorums of flight

THE theory that flying is an activity for supermen only, was expleded so long ago that it is now merely of historical interest Flying is not much more difficult than driving an automobile when one realizes that cars pass each other in modern traffic at a relative speed of over 100 m-p h an hour with a clearance of only a few inches It is evident, however, that flying aircraft will always be a greater problem than driving land vehicles because of the fact that the automobile operates in two dimensions and the airplane in three, and the types of

motion and complication of operation is increased proportionately

Judgment is the pilot's ability to analyze any situation in the air, particularly in an emergency, and to decide what course of action should be followed Sound judgment can be acquired by experience only It is this quality which makes the veteran superior to the novice, no matter how apt a student the latter may be The necessity of having good judgment is illustrated by the following example

Most flying instructors teach their students that the proper thing to do in case of motor failure close to the ground is to land straight ahead, regardless of obstructions in the path, because this will result in less injury to the airplane and pilot than an attempt to turn back into the field Suppose, however, that as a student is taking off an airport toward a crowd of spectators, his engine fails and he does not have sufficient altitude to avoid landing in the crowd if he glides straight ahead He must make exception to the rule and "hook a wing" This decision will be difficult to make, not because of the risk to himself, but because of the habit of thought previously developed, and because the situation is new to him Extensive flying experience enables the pilot to solve each individual problem as it arises

The acquisition of a good knowledge of the airplane motion is mainly a matter of training of vision The student must have good depth perception and be able to use this under the conditions of flight He must learn to judge distance from obstructions and altitude above the ground. While these perceptions can be refined with time, they are usually acquired in the early stages of training and probably will never be acquired satisfactorily except at that time Formation flying is an excellent training of and also a good means of judging, the student's perception of distance

The other source of knowledge of the airplane's motion is the bodily or kinaesthetic sensations, that is, pressure of the body against the seat in a bank and against the fuselage in a slip or skid, and the resistance (or feel) of the controls The sensation of "sloppiness" of the controls in a stall is an example These sensations are valuable adjuncts to those obtained through the eye, but can never entirely replace them. If that were possible, blind flying without the use of instruments would be successful Most flying authorities agree, however, that no human being has so far demonstrated his ability to do this, and that the feel of the ship can only be supplementary to visual or instrumental guidance It is important that the student be trained to understand and accept the unreliability of his senses in blind flying and to have confidence in the available instruments within the limits of their reliability and accuracy

Showing how student on ground can learn control movements by the use of a model airplane

IF judgment can be developed with flying time only and the feel of the ship is merely a supplementary aid to the eye, then it is flying technique, or the co-ordination of eye and muscle on which we must concentrate our attention in primary instruction. There is a wide divergence of opinion among flying authorities as to which sequence of flight maneuvers will give the necessary technique in the minimum of time One of the most prominent training experts in the country, William Winston believes that an adequate and safe dual training can be accomplished in five hours, considerably less than the Department of Commerce minimum of eight hours The reasonableness of this statement has been proven by war experience when large numbers of good pilots were soloed in this time.

It is believed that this statement should be qualified by the requirement that the flying instructor teach muscular control only, and that he does not have to delay or interrupt his instruction by any explanation of the reasons for the acts taught The student must learn the *science of flying on the ground* and the *art of flying in the air* If any slogan is to be adopted for flight training it should be "Mind Before Muscle." Such a system is believed to be the secret of the success of the Wrights and other pioneers in teaching themselves to fly The dangers of their novel experiences forced a cautious analysis of the problems of flight before going into the air, and they were prepared in advance for most of the situations encountered.

A ground school class attending a blackboard talk by an instructor

The procedure of giving a student a knowledge of the theory of flight before he attempts the practice is in accordance with the first of several psychological principles in everyday use in other branches of education

1 The effective and efficient acquisition of proper habits in any act of skill must be preceded by the acquisition of the correct idea and full understanding of the reasons for that act

2. In the building of a logical structure of knowledge (mental organization) the human mind proceeds by a series of periodic fluctuations, from induction to deduction, as follows.

(a) Specific cases suggest a general theory

(b) General theory is strengthened by familiar specific cases, and is tested by new cases,

3 The degree of vividness of the impressions received through the senses is in the order (1) sight, (2) hearing, and (3) touch

4 The degree of attention paid to any impression and the degree of retention are determined by its state of motion Moving objects are more easily noticed and remembered than stationary ones

All these principles must be utilized in ground instruction, or the "science of flying."

A CONSIDERATION of the science of flying logically begins with the methods of obtaining the optimum performance of the airplane under all conditions of flight The importance of a knowledge of these fundamental ideas can be realized if we analyze other learned acts

It is a well-known fact that the average boy can drive an automobile as skillfully as do his parents with a few days' practice Thus astonishes the adults who naturally think that their child is a prodigy Close observation will usually reveal the fact that (1) he has observed the method of driving and knows what to do in the situations he has observed (2) he is intensely interested in the mechanics of the machine

The performance of the airplane depends upon so many variables that to obtain the optimum performance the pilot must observe definite rules of control, which are not yet common knowledge. Perhaps this is because these rules have been discovered by mathematical analysis, checked by flight research, and recorded in reports not widely read by the pilot Even the engineer is usually interested in the maxima and minima of performance and not in the way in which they are obtained by the pilot Several important rules can be illustrated by describing a typical airplane flight

In taking an airplane off the ground there are two governing factors The pilot must manipulate the airplane so that (1) it will not nose over, and (2) it will be able to clear the obstructions at the end of the field with the greatest margin The second condition requires definition Reference is made to Fig 1, where the path of an airplane taking off is represented The airplane starts from rest at A, leaves the ground at B, attains a constant speed at B' and is over the obstruction at C We may assume for the purpose of this discussion that B and B' are coincident

By the geometry of the case it is evident that when once in the air the pilot should cause the airplane to

assume (B to C) its maximum climbing *angle* It is important to note that this is not the condition of best climbing *rate* The latter is of great importance in military air tactics, as it is frequently necessary to climb above an enemy airplane This is of no value in commercial operation, load-carrying and take-off are the important considerations In leaving the ground it is of small consequence whether it takes three, or three and one-half, seconds to clear the trees or other obstructions surrounding an airport, the important thing is to clear them

The pilot must remember that the airspeed at which he must climb in order to secure the best climbing angle is much lower than the speed of best climbing rate This is clearly indicated in the curve of Fig 2, which shows the rate speed curves for a military airplane, as determined by flight test For this plane the best climbing rate occurs at 104 m p h, where the climbing angle is 13 1 ft in 100 ft The pilot climbing this airplane at its best climbing rate would therefore sacrifice 16 per cent of its effectiveness in getting out of a field With airplanes of early design there was some danger in pulling back to this speed in the take-off because of a possible stall and tail spin. Now that control at low speeds has been achieved there need be no such hesitancy. It might also be argued that only rarely is it necessary to obtain the maximum performance in take-off and that all modern airports are large enough to permit of long runs and small angles of climb It is the small-field take-off after an emergency landing, however, that must be considered, as almost invariably the take-off distances are short and many other minor conditions conspire to make the maneuver trying

Returning to the take-off we see that the only remaining question is "How must the pilot operate the airplane from A to B in order to reach this speed of best climbing angle in the minimum distance?" Engineers have found, through mathematical analysis and exhaustive flight tests that, despite all the complicated conditions, the nature of the field is the only governing factor To obtain the required speed in the minimum distance the airplane should be so oriented that the lift coefficient of the wing

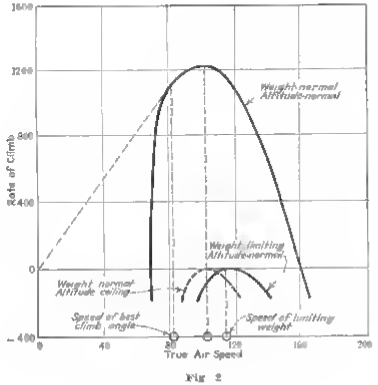


Fig 2

is proportional to the coefficient of rolling friction If the field is smooth the tail should be brought up and held up so that the wings give practically no lift, if the field is heavy or muddy the tail should be kept down so that the wings are at a high angle of attack If the rolling friction is small it will be smaller than the induced resistance, or drag due to lift, and the proper speed will be reached in the shortest run if the weight of the airplane is borne *on the ground* On the other hand, if the rolling friction is large, then the induced resistance will be the smaller and the proper speed will be reached with the shortest run if the weight is borne *on the air*

The rule for the take-off of an airplane may be stated as follows: "To effect the best take-off, hold such an angle of attack during the pick-up run that the lift coefficient will be proportional to the coefficient of rolling friction, until the speed of best climbing angle is reached, after which hold this speed."

STRANGE as it may seem, these simple facts are not widely known The writer has participated in several "indoor flying" sessions between instructors and students in which these rules were the subject of heated discussion Perhaps this is because the obvious exceptions to the rule tend to obscure it If, for example, a fence or other obstruction is encountered in a smooth field (Fig 1-D) then the pilot should zoom over it, thus pulling back on the stick before the sped of best climb has been reached But he should not start tail low with the idea that this will give him more margin to clear the fence If the obstruction is met after he is in the air and climbing steadily (Fig 1-E) then he must zoom but he will have more clearance if he climbs steadily at the best climbing angle up to that point and does not "hold the plane down" after leaving the ground to pick up excess speed This is because, in any mechanism, the minimum energy losses and maximum performance occur when the motion is steady Accelerations and decelerations always waste energy

There are also a number of piloting rules in air work which should be presented to the student One of these concerns the second of the two important operating speeds of the airplane This might be called the "speed of the limiting weight," because of the mathematical formula which specifies it It is the speed at which the airplane would be flying if loaded to the limit of its capacity,—i e, such a load as would bring the ceiling to ground level The angle of attack is exactly the same as for the condition of best climbing angle, but, owing to the fact that the weight to be borne by the wings is greater the airspeed is greater For the airplane, the properties of which are shown in Fig 2, the speed of limiting weight is 116 m p h. which is considerably greater than the speed of best climbing rate

This speed of limiting weight is further important because other optimum performances may be obtained by flying the airplane at that speed It is exactly the speed of minimum radius of turn with full power This maneuver is of value in a take-off where one must turn away from obstacles too high to climb over The student pilot has a tendency to pull back too much on the stick in this maneuver This speed is approximately the speed of best gliding angle the speed to be used when stretching the glide In this maneuver the student pilot has a tendency to use too low a speed For these reasons this speed also might be marked by the manufacturer on the air-speed meter to guide the pilot in operating his plane to the best advantage

THE S.A.E. DISCUSSES FUEL

By Leslie E. Neville

Technical Editor of AVIATION

THREE sides of the aircraft fuel problem were presented during the symposium on this subject, conducted as a part of the recent National Aeronautic Meeting of the Society of Automotive Engineers in Chicago Representative engine manufacturers, transport operators and gasoline refiners were heard and their opinions presented and discussed

Considering the symposium broadly, the principal problem seems to be economic in nature. In brief it is a question concerning the limit to which the quality of aviation gasoline can be raised to provide most efficient use by the operators, assuming improvement of power plant to keep pace with the fuel development

The symposium also brought out the fact that there is a need for a standard of testing and rating fuel by an unbiased organization to insure uniformity of test conditions and a common language for all concerned with the problem

THE first paper in the symposium on aircraft fuel was written by W A Parkins of the Pratt & Whitney Aircraft Company, discussing the fuel problem from the standpoint of the engine manufacturer It was read by E A Ryder At the outset, the author spoke of the effect of fuel quality on cylinder temperatures, stating that the use of fuels marketed for aviation purposes was responsible for increases of 300 deg F., beyond those of normal service He also called attention to the fact that fuel consumption can be lowered as much as 10 per cent with no sacrifice in reliability or performance by using the best grades of fuel commercially available He explained next why an airplane engine must use the better

Experience has shown that at least one transport operator has made greater profits by paying a higher price for his gasoline. Undoubtedly, still higher grades of fuel can be economically justified. Both oil refiners and engine manufacturers are prepared to assist in the solution of this problem as brought out by a recent symposium of the S.A.E.

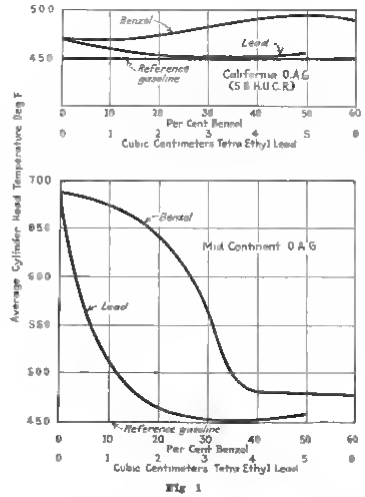


Fig 1

grades of fuel to operate at or below its rating with ample margin of safety In this connection he mentioned recent tests which have shown that with no change either in the compression or design of a standard air-cooled cylinder, ordinary grades of furnace oil can be burned at b m e p. below 100 lb per sq in. without the addition of anti-knock agencies

Another point brought out by Mr Parkins was that of cylinder size He stated that a cylinder of 210 cu in. displacement (the present maximum size) would generally operate about 60 deg hotter than one of half its size, and therefore, will require a better grade of gasoline Continuing his discussion to a third factor, Mr Parkins stated that the compression ratio in air-cooled engines in the past has been kept below 5½ 1, due chiefly to the lack of suitable gasoline Once detonation is suppressed, the average reduction in cylinder head temperature resulting from an increase in compression ratio of from 5 to 6 1 is in the neighborhood of 50 deg F., a gain of considerable importance Records show the majority of piston troubles are directly traceable to high temperatures, resulting from detonating fuel

Fig 2 shows in comparison an engine burning a good and a poor aviation fuel Mr Parkins next brought out that the results from using unsuitable fuel are not always appreciated because its effect on performance is usually

not apparent without the aid of temperature indicators Furthermore, trouble from detonation is usually confused with failures developing from more tangible sources On the other hand the oil companies are without the facilities for converting the relative knock value of gasoline into terms of engine performance, and, without this information, market their products under the Grade B-D A G specifications without considering cylinder temperatures The Pratt & Whitney Company maintains limited free service in testing gasoline and encourages both the refining and the operating companies to submit samples for test The author then described the test which is essentially comparative He proposed that a standard of knock quality between the knock requirements of present Navy and Ethyl Corporation standards be adopted Furthermore, it was proposed that all aviation gasoline meet or exceed this standard without the addition of knock-retarding agents Mr Parkins further stated that once the engine builder is assured of relatively good fuel in all sections of the country, he will immediately increase engine compression ratio, or, by other means, reduce still further the specific weight of the power plant

During the past three years, the Pratt & Whitney Company in all of its tests, has purposely used an ethylized gasoline so as to observe its effect on the engine parts with which it comes in contact Under normal operating conditions and with proper care and storage, it has been found that concentrations of 2 c c's of tetra ethyl lead per gallon of gasoline result in no serious trouble The relative ineffectiveness of benzol at high temperatures eliminates it from consideration as a knock-retarding agent Fig 1 shows in comparison the effect on cylinder temperatures of benzol and tetra ethyl lead in a mid-continent and in a California gasoline It will be seen that the inferior fuel requires 40 per cent benzol to effect the same temperature reduction as 1½ c c's of tetra ethyl lead

While undoped fuel of the quality recommended is suitable for the large 5 1 compression air-cooled cylinder when developing a maximum of 130 lb per sq in, b m e p, the same fuel blended with 2 c c's of tetra ethyl lead per gallon, is satisfactory for the 6 1 compression ratio cylinder at 135 lb per sq in, b m e p

Further progress may be expected, but requires recognition of an acceptable standard of knock quality The expense of producing the superior fuel may at first work a hardship on some of the refining companies and in certain localities, force an increase in the selling price. In all probability, however, the increased cost will be more than absorbed by the savings in decreased fuel consumption

PROBABLY the worst possible condition of gasoline consumption from the operator's viewpoint was discussed in a paper by E. W McVitty, of Pan American Airways Transportation and storage with a number of incidental problems were the subjects of Mr McVitty's presentation The paper was read by C S Kegerreis

Beginning with a discussion of storage of gasoline in climates where the humidity is often very high, the author stated that it has been found that drums seem to collect more water than do other types of containers Drum storage also seems to be the poorest method from the standpoint of evaporation loss

The problem of gum formation was next considered It has been found that gum forms much more rapidly in gasoline stored in drums under tropical conditions than it would in the same gasoline in bulk storage even in a more temperate climate When drums corrode, this action seems to accelerate the formation of gum A gasoline-benzol mixture also seems to form gum faster than pure gasoline even though the gum content of the benzol is entirely satisfactory at the beginning of the storage period According to the author, as much as 200 mg of gum by the copper dish test method have been found in cracked gasoline after storage of two or three months although less than 3 mg of gum were present when the gasoline left the refinery

The knock rating of the same brand of gasoline has been found to vary considerably unless the refiner takes great care to control this quality Changes in knock rating also occur after the fuel has left the refinery

Following extended experience and careful tests of fuel specimens in its complete laboratory at Miami Florida Pan American Airways has set down specifications, following closely those of the Government for aviation gasoline domestic grade There are several modifications notable among which are the distillation range which has been modified and lies somewhere between that for Fighting Grade and for Domestic Grade Gasoline, and the gum content which has been modified to a maximum of 10 mg, instead of the 3 mg required by the Government One added specification is that the knock rating shall not exceed 5 00 on the Standard Oil Company of New Jersey's scale. The test employed for fuel used for the first time by Pan American Airways also was described

From the experience of Pan American it is believed possible to specify a gasoline which will not cause vapor lock nor poor distribution for a given type of equipment under given operating conditions The exact limits for these requirements are much more difficult to specify, however, and moreover, insufficient data are available showing the specific effects of distillation range on such important items as power output and fuel consumption

It has always been difficult to secure benzol which would pass the copper dish corrosion test in a fifteen per cent benzol-gasoline blend, even though the benzol would not discolor a copper strip immersed in it for three hours at 122 deg F., and although the sulphur content of the benzol was less than 0 09 per cent

In spite of these and other difficulties it has been possible to secure satisfactory benzol

THE viewpoint of the Materiel Division of the Air Corps was presented by S D Heron, of Wright Field Dr Heron classified these requirements under five headings (1) Anti-knock value, (2) volatility, (3) vapor-locking and starting properties, (4) gum, (5) available fuels and anti-knocks, in the order of their importance

Beginning with the first of these, Dr Heron stated that the fuel required depends upon the design of the engine, the compression ratio, the degree of supercharging the design, size and temperature of the cylinder unit and the rate of revolution He next discussed the approximate anti knock value of three grades of gasoline ranging from 50 octane (2-2-4 tri-methyl pentane) 50 heptane, 70-75 octane, 30-25 heptane, to 87 octane 13 heptane, stating that the medium grade was amply good for most modern commercial and military engines with the exception of high compression and ground-boosted types and with certain reservations as to fuels which show excessive loss of anti-knock value at high cylinder temperature

Relative anti-knock values of fuels for aircraft purposes appear to vary widely with test-engine conditions, at least when tested by the method of working at part throttle and a pronounced knock The most pronounced change in relative values is produced by variation of cylinder temperature, particularly when comparing lead and benzol in highly naphthenic California gasoline. In measuring detonation by the tendency to heat the cylinder units, the Materiel Division has found that the amount of tetraethyl lead required to equal 50 per cent benzol in a California Fighting Grade gasoline varies by several hundred per cent between the limits of 200 and 400 deg F cooling-liquid temperature, the lead requirement rapidly dropping with increasing jacket temperature. Similar tests in an average Mid-Continent D A G showed that, between the limits of 150 and 400 deg F jacket temperature, the lead equivalent of 50 per cent benzol varied by over 100 per cent The lead equivalent of 50 per cent benzol has also been found to be subject to more than 100 per cent variation, both as a result of change of rate of test-engine revolution and of knock intensity

There is evidence that the relative tendencies of fuels to knock audibly and their tendencies to heat the cylinder unit are not always equal Therefore, a temperature method of rating fuels for aircraft use may prove to be more desirable than one depending upon intensity of knock Evidence has been obtained in multi-cylinder aircraft engines which suggests that tetraethyl lead has an effect in suppressing overheating of the cylinder unit which is out of proportion with its properties of suppressing audible knock and controlling the ratio of pressure rise

As aircraft engines vary widely as to cylinder temperature and rate of revolution, the problem of measuring the anti-knock values of fuels in terms of their usefulness in multi-cylinder engines is very complex. The Air Corps has recently issued a tentative suggestion Specification Y-3557 for Fighting Grade Anti-knock gasoline At this point Dr Heron set forth the difficulties found in the experience of the Materiel Division in knock testing at high cylinder temperature

Discussing volatility, the second of his five headings, Dr Heron stated that the Air Corps has adopted Federal Fighting Grade volatility requirements with the substitution of a 10-per-cent-evaporated point for the present 5-per cent-recovered point Fuel injection devices now being tested and injecting either into the combustion-chamber or the induction system may permit of the use of much less volatile fuel

Vapor-locking was next discussed as an intermittent difficulty with present Air Corps equipment, and gasoline with a ten per cent evaporated point much below 150 deg Fahr violently accentuates the trouble The Air Corps tentative specification has adopted the limits of 144-162 deg F. for the 10-per cent-point and the lower limit can hardly be lowered until fuel systems are improved. Even if the fuel systems are so improved, it is possible that any considerable lowering will be undesirable on account of fuel boiling in the tanks of supercharged airplanes which may reach 30,000 ft altitude in 20 min with virtually no reduction of temperature of the fuel in the tanks

The Bureau of Standaeds test has shown that in propane-free gasolines, the ten per cent evaporated point gives a very close estimate of the vapor-locking temperature of the gasoline at 760 mm Hg pressure Apparently, the Air Corps is receiving some gasoline containing propane, as the Reid vapor pressure at 100 deg F of samples of D A G with almost identical 10 per-cent evaporated points is differing by as much as 1½ lb per sq in Appropriate modification of the specification pertaining to this limit is probable.

Dr Heron next told of endurance tests in flight using cracked aviation ethyl gasoline and showing no undesirable effects from the use of a cracked base The fuel used in these tests was admittedly low in gum (below 10 mg glass dish after accelerated aging with oxygen) and quite gum stable He stated that the present Federal Specification of 3 mg of copper-dish gum for aviation gasoline virtually excludes all cracked gas and are not very generally met by much of the straight-run fuel. The Materiel Division has tentatively specified an accelerated aging test with oxygen and is financing an investigation of the relation of accelerated aging tests with storage conditions at the Bureau of Standards

Dr Heron next spoke of the availability of fuels and anti-knock. He stated that, of the dopes, tetraethyl lead is at present the only one of interest for large scale use Many present types of aircraft engines develop trouble when operated on fuels containing tetraethyl lead Several, however, are virtually free of operating troubles from this cause Engines requiring fuels with anti-knock ratings of the order of 87 octane are all of the super-performance type and the troubles arising with lead are vastly less difficult to overcome than those caused by insufficient anti-knock value It has been found by the Air Corps that all of these lead troubles can be overcome by design, material and lubrication changes

Knock tests at 300 deg F. jacket temperature of cracked gasolines without lead addition against the best of the straight-run California gasolines without added lead show that the cracked base is in cases superior in anti-knock value This superiority usually disappears when lead is added to both, the lead response of some cracked fuels appears to be slight and in other cases is virtually nothing after a particular concentration has been reached As a result of recent experience, the Air Corps does not feel that the present sulphur limit of 0 1 per cent for the finished fuel can be raised nor the copper-dish corrosion test be abolished

THE first representative of the fuel producers was C M Larson of the Sinclair Refining Company, who appealed for reduction in the number of specified grades of aircraft fuel Analyzing the consumption figures for 1929, he contrasted them with the relatively large annual consumption of gasoline by motor vehicles and pointed out that the problem would be simplified if aviation gasoline were of one standardized grade

The author next analyzed grades of aviation gasoline and showed that four of the five grades covered by specification were in many respects identical He attributed this situation to the difference of opinion as to what method shall be adopted so that a suitable anti-knock value may be determined

He advocated as a first step, raising the gum content of aviation gasoline from 3 mg to at least 20 mg. He stated that a 70-hr test made on 48 mg aviation gasoline showed no trouble due to deposits or sticky valves and showed lantern slides in support of his statement

In closing, Mr Larson suggested a standard specification to cover one aviation gasoline, with a reasonably high anti-knock value to be used for private flying and aerial service, as well as by scheduled transport consumers, and possibly one other, but not more than one

additional specification to cover aviation fuel for the Army and Navy and such scheduled transport lines, as well as those consumers who may desire to use supercharged engines, all of whom find it necessary to go to compression ratios higher than 5 1 1 for air-cooled engines

THE fifth speaker was Mr J H Doolittle, of the Shell Petroleum Company who confined his presentation to the subject of volatility requirements in aircraft fuels Mr Doolittle stated that four factors which make the aircraft engine dependent on fuel volatility are ease of starting distribution, freedom from vapor-locking troubles and fire hazards Each of these factors, he added, demands that a certain percentage of fuel shall or shall not be evaporated under a given set of temperature and pressure conditions We are able, therefore, to arrive at a satisfactory specification for fuel volatility and a careful study of typical designs of fuel feed systems and manifold constructions and the knowledge of the fundamental requirements of these features with respect to the amount of fuel which must be evaporated in these systems at their working temperatures to give satisfactory performance, he continued This problem resolves itself into two phases, first a study of fundamental volatility characteristics of any given fuel and the various means of measuring these characteris tics, secondly, the question of the practical application of these characteristics and their effect on engine per formance, ease of starting and good distribution

Considering the first phase of the problem, Mr Doolittle concluded that the actual basic measurement of the volatility of the fuel is an air equilibrium distillation curve In this connection, he cited the familiar work of Dr Bridgeman of the Bureau of Standards is computing this curve with a certain degree of accuracy from the ordinary A S T M distillation curve between 10 per cent and 90 per cent evaporated

RESTRICTING his presentation to the subject of knock values of aviation fuels, Captain E. E Aldrin of the Standard Oil Company of New Jersey began by stating that the debate regarding relative knock values of various aviation fuels is due largely to the absence of common language and uniform test conditions Captain Aldrin continued by saying that it was nearly impossible to compare the effect of fuels in water-cooled and air-cooled engines whether they be full scale or test engines

The basis of Captain Aldrin's presentation, a chart (Fig 3) set forth data obtained from testing of various aviation engines in the laboratory and in flight with different kinds of fuels The second portion of his paper was devoted to a criticism of his chart and an explanation of its characteristics In conclusion, Captain Aldrin stated that the importance of knock value in aviation engines cannot be overestimated He spoke of the advantages of high knock value and stated that such questions as have been up for discussion previously had not been considered in his paper because of his belief that more practical experimental evidence should be obtained before the relative importance of these questions is discussed

LEADING the discussion, Mr R E Wilson, of the Standard Oil Company of Indiana, first criticized the statement in Mr Doolittle's paper that fire hazard was a danger from gasoline of too high volatility He stated that it is only the comparatively non-volatile gasolines at rather lower temperature which will get into the explosive range Mr Wilson then called attention of the meeting to the fact that there are methods of adding certain anti-oxydizing agents or passivating agents to cracked gasoline which very greatly decrease the tendency to form gum on storage He further stated, that in general the gum formation and the loss of anti-knock are problems which go hand in hand He then pointed out that it is meaningless to say whether a gasoline of a certain test does or does not form gum Criticizing Mr Larson's paper, he stated that in his opinion anything even approaching 40 mg of actual gum in gasoline would produce serious deposits in the engine On the other hand, Mr Wilson added that the present limit of 3 mg of gum in the Army Specifications was in his opinion too low to permit the development of improved types of fuel at lower cost than would otherwise be made available

With regard to the limit on vapor-lock of 6½ lb vapor pressure, Mr Wilson stated that in setting any rigid limit, in spite of the fact that it is somewhat necessary, you are interfering both with the ease of starting and the anti-knock value of the gasoline which you can get by natural means In practically every type of gasoline, the more light ends you have the better end knock you

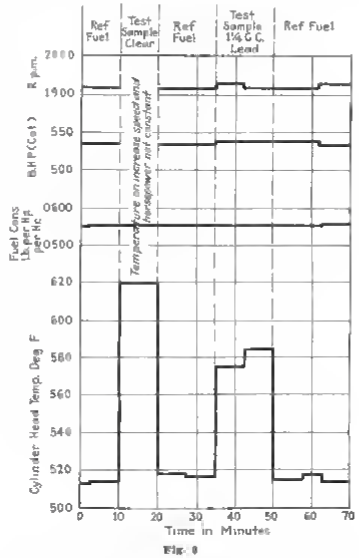


Fig. 2

will have In connection with the evaporation losses in storage mentioned by Mr McVitty, Mr Wilson suggested the use of either the floating roof or the breeder back protective storage.

The second speaker in the discussion was Edward P Warner, president of the society Mr Warner traced the history of fuel research by the S A E from the high way vehicle stage to the present time with particular emphasis on the period since 1928 Stressing the economic aspects of the question, he mentioned a formula worked out by him which in general shows the value to the commercial aircraft operator of reduction of fuel consumption and reduction of frontal area. In closing he stated that it was his opinion that it was worthwhile going much farther in the improvement of engines and fuels to match than anyone had seriously attempted to go as yet, even though the fuel cost per gallon might be slightly higher

At this point, Chairman Smith stated that he agreed with the last statement of Mr Warner As an example, he cited that his company, National Air Transport, had recently made a change in the fuel it was using Although the new fuel is more expensive, the company is making more money as a result. It has less trouble with its engines and fuel consumption has been reduced slightly He then stated that the next step was for the engine manufacturers to produce units to burn the better fuels economically and efficiently.

In discussing Mr Warner's remarks, Mr J H Geisse interpreted them as an attempt to find by a formula how much premium we can pay for anti-detonating fuel He stated that the formula would depend entirely upon what kind of service you are discussing because the saving is not only a question of saving in the fuel itself, but it is in the cost of carrying the fuel It also depends on the number of hours' operation

Following Mr Geisse, Dr Heron brought out the point that benzol and tetraethyl lead work quite differently in their anti-detonating characteristics, depending upon temperature. Most of his tests were based on increasing cylinder head temperature which undoubtedly is the correct thing to do Benzol will cause an increase in cylinder head temperature independent of detonation

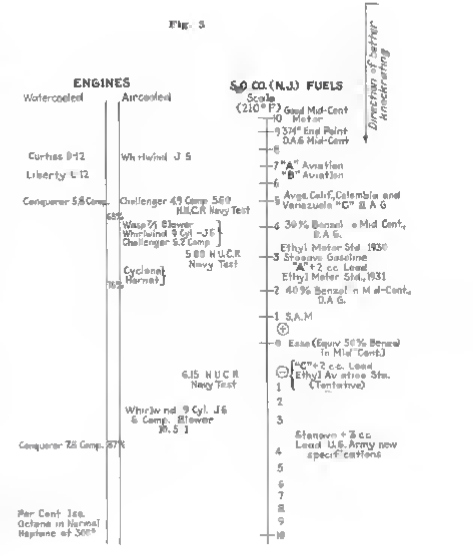
Mr Geisse next passed to the question of pre-ignition or auto-ignition Discussing a statement of Dr Heron that in the benzol he had some after-fire in addition to the increase in cylinder head temperature, Mr Geisse pointed out that that again is a different problem than detonation The different fuels have entirely different ignition points Benzol, as a matter of fact, can ignite without a spark plug at all in about 14 to 1 compression ratio In closing Mr. Geisse stated that it was absolutely essential to find some standard method of rating gasoline and some organization to test these fuels and rate them

From this the discussion turned to vapor lock and Prof G G Brown asked for an amplification of Major Aldrin's statement that occasionally the 90 per cent point on the A S T M distillation might be far more significant indicating vapor-lock than the vapor lock of gasoline

Mr Aldrin replied that the 90 per cent or the end point may have considerable effect on the vapor locking tendency of the gasoline just as much as the vapor pressure values that are obtained at 100 deg. As an example, he cited two gasolines that run on 8+ free vapor pres sure, one has an end point around 330, another an end point around 270 The latter gives trouble in vapor lock and the former does not

Dr Brown then explained his reason for his question. It was contrary to his experience that there can be large differences in 90 per cent point with about the same ten per cent point, same vapor pressure, and the fuels showing about the same tendency to vapor lock He suggested the possibility that there might have been other factors that came into the test to which Major Aldrin referred He then stated that the ordinary commercial

Fig. 3



flying ships seem to be able to handle in a satisfactory manner at the present time fuels with a vapor pressure running in excess of 10 pounds He attributed the Army difficulty with vapor-locking to the fuel system layout as well as the characteristics of the fuel He suggested that more attention be given to fuel system layout than has been in the past

Mr Zublin next spoke corroborating Dr Brown's statement and concluded by agreeing that vapor lock has been greatly exaggerated and adding that certainly nothing should be sacrificed for protection against it.

At this point Mr Giesse again took the floor stating that the difference in vapor-locking troubles between military and commercial planes was probably the fact that military planes were compelled to use a fuel pump

Dr Bridgeman followed him in the discussion stating that from the work done at the Bureau of Standards, the temperature of the gasoline in the tank as it leaves the ground seems to be the controlling factor in the matter of vapor-lock After citing an example, Dr Bridgeman said that Mr Heron's statement of 6½ will probably apply perfectly well to hot weather flying As a remedy for vapor-locking trouble, he advised keeping the gasoline in the tank at the ground as low as possible in temperature and the provision of the best possible thermal contact between the tank and the atmosphere so that the temperature will drop as the airplane gains altitude

Chairman Smith next spoke citing an experience in the operation of National Air Transport Following progressive redesign of the fuel system of its planes the N A T had no appreciable vapor-locking troubles until the use of fighting grade gasoline was initiated Since then, it had four cases of vapor-lock in the Southwest in sixty days These always occurred in the daytime

THE TOUR IN RETROSPECT

By John T. Nevill

Detroit Editor of AVIATION

Some interesting comments on the good and bad features of the 1930 commercial air classic

IN THE opinion of many the 1930 National Air Tour was the most successful Air Tour ever held It proved beyond question its sponsors' claim—that it is a flying laboratory par excellence It took the contesting airplanes over a varied 4,800 miles and brought them all back to their starting point with efficiency records almost unbelievable ft also took the accompanying planes over the same route, practically all of which returned with the same sort of record The 18 planes competing for the Edsel B Ford trophy, and the dozen odd official and accompanying ships left Ford Airport Detroit, on the morning of Sept 11 and returned Sept 27, after flying on schedule over 4 800 miles The trip took them to 14 states and 3 Canadian provinces

The same scoring formula was employed to score six single engined cabin land monoplanes one single engined cabin land biplane, two tri-engined cabin land monoplanes, one twin-engined cabin land monoplane, six open-cockpit land biplanes, one open-cockpit land monoplane, and one cabin monoplane amphibion Including the pilots, Tour officials company representatives and newspapermen, more than 80 men and women made the trip, and all of the planes that started, except two accompanying craft, completed the schedule with remarkably little difficulty of any sort One of those was forced out because its tiny engine could not combat terrific headwinds encountered during the early stages of the event, and the other was wrecked while landing at night on an unlighted airport not on the Tour's route

In discussing the recent Tour with respect to the way it was carried out it is possible to list the subject matter in what it is believed is their proper order of importance First, the scoring formula and the rules, second the timing and scoring, third, the Tour's relationship with the press, fourth, the handling of airport spectators fifth, transportation and hotel accommodations, and sixth, entertainment Each of these, of course, bears a direct relationship to the Tour management

There is little doubt that the formula adopted for the first time this year, is the best and most equitable yet conceived considering the great variety of craft against which it must be applied Even those who charge it with partiality toward certain types of craft admit that. It divided horsepower into contest load, then added the dividend to the takeoff and landing time of the ship after which the sum was used as a constant throughout the Tour and multiplied by actual leg speed in order to give the number of points accumulated during the leg Speed, therefore, was a most important factor, and turned the Tour into the best airplane race of its kind Nearly all of the competing pilots, especially those who were "in the money," or had an opportunity to get there flew around the long course with their throttles wide open thereby subjecting their engines, their planes and themselves to a most thorough and rigid test It is no little tribute to the builders of those engines and those planes to say that comparatively little trouble with either ensued It can even be said that mechanical trouble occurring on this year's Tour was less than that occurring to Tour planes during any other preceding event when planes were flown around the course at little more than cruising speed and both plane and engine were "babied" along from control point to control point Such things as blown spark plugs, broken valve caps broken exhaust tappet collars blown tires loose cowlings and low oil pressure constituted the usual run of mechanical difficulties, although there were three cases of loose cylinder heads necessitating installation of new cylinders one or two scored pistons, one broken exhaust valve spring retainer, and one very interesting case in which a ship's metal skin would not stand the terrific speed to which it was subjected All of these occurrences have served to point out weaknesses in the engines and craft and no doubt most of those flaws are now in process of correction

Speed placed in the formula automatically involved another factor not mentioned in the formula That was

At the completion of the tour The winning plane is in the foreground

the piloting and navigating ability of the contestants Never before in an airplane event of this length has precision performance played so great a part Pilots stuck closely to the pencil line on their maps many of them often passing over the same farmhouses 50 or 60 miles out on their course Stop watches were part of the equipment on any instrument panel, some of the more particular pilots carrying two or three of them

The Tour pilots saw in the 1930 formula a noticeable advance over that formerly used However, at the pilots' meeting which always follows the National Air Tour some interesting, though not new, criticisms were offered Some of the opinions expressed at the meeting

Capt George W Haldeman, Bellanca pilot "I believe the Tour henceforth can get along without stick and un stick. Stick and un-stick were placed in the formula to develop brakes That has been done I also believe the two-hour working rule is a good one because it prevents major overhauls but it has taken away the possibility of demonstrating our planes There should be a compromise."

Charlie Meyers, Great Lakes pilot "If stick and un stick must be in the formula let them be recorded throughout the route If they are taken at least two or three times over the route they will have been taken under actual operating conditions"

John Livingston, Waco pilot "Leave stick and unstick in the formula High altitudes are the best tests of the worth of brakes We saw that on this Tour at Cheyenne If quick landings and takeoffs are not important any more why do we need variable pitch propellers?"

Bart Stevenson, Monocoupe pilot "The rules do not provide enough time to check our engines Rich companies have an advantage in that they can send along an army of mechanics who can do almost any job within the two-hour limit They could even rebuild the ship in that time. The rules are not specific enough They should limit mechanical work to a certain number of man-hours daily I would say eliminate the stick and un stick"

Eddie Schneider, Cessna pilot "Stick and un-stick are unnecessary I also am in favor of putting more long hops on the route, with the provision that if an entry lands for gas it will be penalized"

O. G Harned Kingbird pilot "Cut out the stick and un-stick, and demand that all Tour entries be production models, planes that a man can buy if he so desires Some of the planes in this Tour (referring to special design with high landing gears) were built upon stilts and need no brakes at all. They come in to land with the whole bottom of them pushing the air, an angle of attack that would stop anything"

John Livingston, Waco pilot "High stilts, as they have been called, are perfectly all right. They show development, show we have learned something

William B Mayo, chief engineer, Ford Motor Co: "Surely if high stilts add to a plane's efficiency they are legitimate"

Jack Story, Rearwin pilot "The formula is a good one for cabin planes but I can not say as much for the open type I would like to see the entries classified"

George Meissner Sikorsky pilot "Eliminate stick and un-stick and give more credit to amphibions."

Carl Schory, Hamilton Standard Propeller Corp: "The Tour formula should consider pay load rather than useful load and the route should contain three or four jumps of approximately 400 miles"

Arthur G Schlosser engineer, Detroit Aircraft Corp, chief scorer "Limit the Tour entry list to stock models The idea of specifying the number of man-hours relative to repair work is a good one Stick and un-stick is important to the private owner so I believe it should be kept in the formula If stick and un-stick is eliminated we must find some way of handicapping the heavy planes"

Leslie Bowman, Kinner-Waco pilot: "The two or three place ships have no place in the Tour Stick and un-stick is not needed by transport planes I am in favor of using payload in the formula instead of useful load"

Harry Russell, Ford pilot "Two hours is not long enough to work on three engines, so many man-hours per cylinder should be granted I also would like to see the Tour travel at least 1,000 miles per day"

Miss Nancy Hopkins, Kitty Hawk pilot "I have no quarrel with stick and un stick My ship will have brakes next year I do believe, though, that all entries should be stock models"

IT WILL be noted that some of the pilots emphasize the need for assigning each ship a certain number of man-hours for repair work Those remarks were inspired by the fact that several of the contestants worked on their ships during hours not allowed by the rules, and also by the fact that ships enjoyed the service of three or four mechanics while others had but one Some pilots worked on their ships during the noon stop over, the legality of which action is not quite clear in the rules

The present formula was adopted only after many

others had been experimented with, and after as many changes to it had been considered and discarded The rules committee during last winter worked many long hours over it, and, with a few notable exceptions, never received much cooperation from the manufacturers The formula was adopted over the protest of the Waco Aircraft Company, winners for two years under the discarded formula the committee feeling that if the Tour was to be continued the formula then in use must be shelved inasmuch as a large majority of the participating airplane builders had become thoroughly dissatisfied with it

Since a majority of the present complaint seems to be leveled against the stick and un-stick factors and since some of the more faithful participants want those factors left in, perhaps the committee can compromise by using either the square or the cube of the sum of stick plus un-stick, instead of using the sum itself This suggestion was made last winter by Mr Schlosser, who is a member of the rules committee, but was not adopted It has been charged that the present formula is partial to cabin planes, especially multi-engined cabin planes This, we believe is an unfair insinuation, though it may not be intended as such A glance at the final standings in Detroit will show what the new formula has done The seven cabin planes and three open cockpit biplanes were among the first ten positions There were four more cabin planes in the Tour than there were open planes A tri-engined cabin plane was first, next were two open cockpit biplanes, leading another tri engined cabin plane, a dual engined plane, and four single-engined cabin planes The tri-engined cabin plane came in first because of one thing! Only the total rated horsepower of its least efficient combination of engines was used in its formula instead of the horsepower of all three engines This reduction is provided for in the rules on condition that the plane can maintain level flight above 6,200 ft for 15 min. while using only its least efficient combination of engines. It cannot be denied that performance like that is not desirable, nor maintained that it should not be recognized in an efficiency scoring formula If his plane had not been able to pass this efficiency test with the consequent employment of its total rated horsepower, which was 1,020, Russell's constant or "figure of merit" in the formula would have been something more than 10 instead of the 14 8 which he did have And with a constant of less than 11 he would have been very fortunate indeed to have any position in the money As a matter of fact, Truman Wadlow was the only pilot with a constant of less than 11 that managed to get "in the money" and he just made ninth position by averaging a speed for the 5,000 miles of 132 6 m p h Russell's average was 131.9 m p h

TIMING and scoring on the recent Tour were carried out with a smoothness never before approached, although there were one or two more or less inexcusable mixups due to carelessness Mr Schlosser and Mr Crocker, the Tour's veteran scorers, were not at fault in either case In two cases leg mileage was listed incorrectly on the logs and in one case the scores were calculated on the basis of an incorrect starting time. Comparatively speaking, they were but slight errors and other than causing some inconvenience to newspapermen were of little importance As an over-estimated leg mileage gives an advantage to fast ships and an underestimated leg mileage to slow ships, it is suggested that the official Department of Commerce airline mileages be procured before the start Similarly, correct mileage between Canadian stops could be obtained from Canadian aircraft officials

Aside from the Tour's value as a laboratory for manufacturers, one of its primary uses is as a means of publicity—publicity for the industry as a whole as well as for individual ships It is the opinion of the writer that neither the Tour management nor the participating manufacturers have ever taken advantage of the Tour's publicity possibilities Some commendable efforts have been made, but they seem to fall down at the critical point This year the management employed a former newspaperman who is a publicity specialist However, he was not carried along on the Tour, which was an error Then, too, his employment came at a late hour, with the result that the event did not receive nearly its due share of preliminary notice

THIS year, like all preceding years, there were three major complaints concerning publicity One was that there was not enough of it The second was that it was not properly divided The third was that most of what there was was incorrect All three of these charges are well founded The first of the complaints—not enough publicity—is the cause of the last—what there was, was incorrect For reasons explained before, newspapers over the country, particularly those along the Tour route apparently were not thoroughly familiarized with the Tour before it started and, seemingly, no effort was made to mail out last minute changes and other information after it began Therefore, some pilots landed in certain towns to find, according to the local papers, that they were not flying their planes at all, or else that their names had been changed unknown to them Others were astounded to learn that they were no longer working for the concern that had been sending them pay-checks, instead they were flying their ships for some other firm Others who were flying an engine's company's service plane, discovered that their ship was powered by a competitor's engine

Such journalistic errors may have been caused by any number of reasons By an unqualified or careless reporter, by an unqualified or careless re write man, or perhaps by an unqualified and careless editor But behind it all is the probability that the Tour committee didn't see that the correct information was in that newspaper office. The Tour cannot expect to monopolize a lot of space in the large metropolitan newspapers Except in Detroit, where the Tour originates, its visit amounts to just a little more than an occurrence in the city's daily happenings But in the small cities and towns, the arrival of the Tour is big news A lot of those small town stories were incorrect, however, because they had not been sent the correct information, coupled with the probability that they did not know one plane from another

There is very little that can be said about entertainment on the Tour except that there probably is a bit too much of it It is certain that most of the pilots would like to see some of the nightly banquets eliminated Their presence at the banquets, no doubt, is a courtesy they owe to the people of the city who are their hosts, even though some of the speeches do become irksome at times Wichita, which city has had the National Air Tour probably more times than any other municipality, and knows something about the pilot's attitude toward these dinners, very wisely neglected to have one this year Most of those on the Tour appreciated the city's thoughtfulness.

HOW I FLEW THE TOUR

By Harry L. Russell

THE most interesting point of my participation in the recent National Air Tour lies in the airplane I flew For, in the final analysis, the airplane's pilot is little more than incidental to the victory

The ship I used was a standard model 7-AT all-metal Ford cabin monoplane, powered by one 420-hp Pratt & Whitney Wasp and two 300-hp. Wright Whirlwind engines As a matter of fact it was the same airplane flown on the Tour last year by my 1930 team mate, Myron E Zeller, who succeeded in winning third place under the 1929 formula. Immediately following last year's Tour the plane was placed in service on our freight airline between Detroit, Chicago, and Buffalo. After almost a year's service hauling aerial freight, it was relieved of that comparatively prosaic duty to be prepared for entry in the Tour. This preparation included the installation of two new Wright engines in the wing mounts, the installation of an overhauled Wasp in the nose, and the placing of streamlined pants on its wheels The latter, incidentally, was the only change capable of affecting the ship's resistance Prior to the Tour, the nose engine had been in use for approximately 400 hr

Some personal comments by the man who piloted a Ford Tri-Motor (Model 7-AT) to first place in the 1930 National Air Tour

When Mr Zeller flew the ship in the Tour last year, the total rated horsepower of his nose and right wing engines, a total of 725, was employed in the formula against him This was in accordance with the rule permitting multi-engined ships a reduction of actual horsepower to the total rated horsepower of the least efficient engine or combination of engines—provided the plane can perform satisfactorily while using only those engines The total rated horsepower charged against me in this year's revised formula was that of the two wing engines, or 600 Thus, of course, gave me an advantage that Mr Zeller did not have. However, this year's formula demanded the utmost in speed at all times, whereas last year a Tour pilot had to maintain only 85 per cent of the maximum speed recorded in his preliminary tests at Ford Airport The difference in the ship's standing this year and last, probably is due to last year's slightly longer route and to the fact that the 1929 formula did not hold quite as high a premium on speed.

AT THE preliminary tests carried out just before the beginning of the Tour the Contest Load of my plane was set at 5,630 lb but it was given 5 per cent additional credit for being a cabin plane—this in accordance with the rules—therefore, the theoretical load carried in the formula was 5,630 plus 364, or 5,995 lb In reality, the plane was overloaded, and carried its gross load, 12,910 lb , except for fuel consumed en route all around the Tour At Cheyenne which is 6 200 ft , highest point on the route, we landed about five miles an hour faster than the ship ordinarily does Then with the full gross load of the plane in force, we took off in the heat of the day, leaving the runway with plenty of room to spare

The ship's Stick in the preliminary tests was 11 46 sec and its Un-stick, 11 58 sec , making a total of 13 04 sec In the formula my Load, 5,994 was divided by my horsepower, 600, then added to the arbitrary figure, 160, divided by 13 04 plus 10, another arbitrary numeral, to give the resultant, 14 8, which was used as a constant and multiplied by the ship's actual speed to give its number of Tour points My plane's constant it should be explained, was eight-tenths of a point higher than that of the Cessna, which held the second highest among the entries

Since the Tour rules forbid any change of propeller pitch, unless the pitch is controlled from the cockpit or cabin, and since there are no variable pitch propellers on the market at this time we had to use our judgment relative to the proper pitch needed before we left Ford Airport The pitch of my outboard props were set at 15 75 deg., while that on my nose engine was 14 33 deg

This was sufficient to allow me a maximum of 2,060 r p m with my new engines at the start After about five hours operation by which time we had begun to reach cooler weather, and by which time my engines had become worked in, I was able to turn them up to 2 100 r.p.m

ON the initial flight from Detroit to Chicago, the newness of my engines and warm weather combined to cause my engines to heat up Whereas normal oil temperature on these engines is around 170 deg , my outboards were registering 185 and my nose engine showed 190 deg Going into Chicago therefore I had to reduce my r p m to I 900, which brought my average speed over the Kalamazoo Chicago leg to 122 8 m.p.h. much slower than it should have been under favorable flying conditions

The heating jinx pursued me the following morning during the Chicago-Davenport, Ia leg helping a cross-headwind to hold my speed to 128 1 m p h On the afternoon's hop to Wausau Wis however my engines had loosened up bringing oil temperatures back to normal A tailwind during this flight helped to set an average speed of 145 1 m.p.h., one of the best I enjoyed during the Tour Although my average speed for the Tour's 30 legs was 131 9 m p h., my ship twice averaged a leg speed of 155.7 m p h

The next morning, shortly after the take-off for Eau Claire Wis , the oil pressure of my left wing engine dropped from a normal 60 lb to about 10 lb , making it necessary for me to cut it out and finish the remaining 94 miles through a headwind into our destination with two engines It was said by some of the boys (several of them having experienced the same trouble) that the containers with which our ships were oiled in Wausau could not have been clean At any rate the crank cases affected were drained and re-filled at Eau Claire and the trouble did not re-occur We averaged only 99 5 m p h on the morning leg the slowest speed we had during the entire Tour

No more mechanical trouble crossed our path, until we started the leg between Winnipeg and Brandon Man About 20 miles from Brandon while we were bucking a 40-mile headwind my mechanic Chic Barsik noticed number eight cylinder head on our left wing engine jumping up and down I immediately cut the engine and again flew into a control point on two engines It was discovered in Brandon that the cylinder head had loosened, breaking the exhaust and intake manifolds and the spark plug wires before we observed it We installed a new cylinder, welded the manifolds and replaced the wires before the start in the afternoon for Regina Sask

Everything went along splendidly for the next five days Then at Cheyenne, just before our take-off, we noticed a little oil on one side of one cylinder head and barrel on our right wing engine Not having time to change it, we flew to Denver, checked it again and found it just the same In Colorado Springs, however, we found oil coming out all around the cylinder, so we replaced it Like the cylinder replaced at Brandon the head had become loose

Except for the breaking of an exhaust tappet collar on a cam follower of my left engine and the breaking of 15 sparkplug wires, discovered on the airport at Regina the foregoing comprises all of the mechanical trouble suffered by my plane during the Tour The broken tappet collar was found in Chicago the follower having dropped one-eighth of an inch Fortunately, we had enough adjustment left on the valve tappet to complete the Tour without making a change

The broken plug wires amount to something of a mystery and I hesitate to classify that as mechanical trouble Ordinarily, when going in to land I check my magnetos and I am certain that I did so before landing at Regina Yet, the following morning, upon arriving at the airport to prepare the ship for departure we found the 15 wires pulled loose from their terminals The terminal ends of all of the wires apparently had been pulled out of their sockets, and, somehow had found their way back in before we arrived on the scene Although it is hard for me to believe that clean breaks, such as they were, could be caused by vibration, I certainly do not mean to intimate that any member of the Tour party had anything to do with it There are, however, a large number of cranks in this world who would not be above doing a thing of this sort So from Regina on we saw to it that our planes were guarded

From the foregoing paragraphs one might get the idea that my plane experienced an over-abundance of engine trouble That is not so Nor is it so with any other plane in the Tour Considering the rigorous test to which the engines were subjected the actual amount of engine trouble encountered was slight

Navigating the 1930 Tour route was a simple problem Most of our route was covered with section lines and many good landmarks The toughest portion, from my viewpoint was through the mountains of Montana and Wyoming where mountains represented almost our only guide The peaks among those mountains though, were well marked upon our maps so that it did not require too much effort to remain on the course.

BEFORE closing I would would like to add a few remarks about the Tour formula and rules There has been a lot of talk about abandoning the use of stick and un-stick in the scoring formula. I believe that is a mistake Stick and un stick were placed in there to develop brakes and brakes are not yet all they should be The industry is constantly building larger planes, but our airports are not growing larger A mile square is just about the limit on airport area and there is no economical reason why they should be any larger As our planes grow larger and more numerous we must devise ways to get them into and out of the airports we have So I suggest we leave stick and un-stick in that formula

Some pilots want piston displacement used instead of horsepower That has been done on all other National Air Tours I see little difference between the two There also has been some calling for the use of payload instead of useful or contest load It seems to me that useful load would be more beneficial to certain airplanes as it is generally known in the industry that certain planes will not perform with the payloads they are advertised to carry Speed is splendidly used in the formula as it reveals weaknesses and paves the way for improvement The right of multi-engined planes to a reduction of horsepower used in the formula if they can carry their useful load in level flight at 6,200 ft cannot be challenged so long as efficiency means anything in the Tour We should have more time to work upon our engine or engines, with a certain number of man-hours per cylinder being allotted each pilot The rules could be a bit clearer as to the times pilots are *not* allowed to work upon their engines, and disinterested guards carried by the Tour should be placed on the airport to see that such work does not go on

CRASH FIRE TESTS WITH DIESEL OIL

By C. Fayette Taylor and Edward S. Taylor

Massachusetts Institute of Technolog

A NUMBER of tests were made at the Massachusetts Institute of Technology last spring, in order to determine the relative difficulty of ignition and speed of development of fires under conditions simulating wrecked airplanes, using gasoline and "Diesel" oil respectively No attempt was made to determine the relative likelihood of ignition conditions being present A number of tests were made with each fuel with a "standard fire" The results showed (1) that both gasoline and fuel oil ignite readily from a red hot surface, (2) that with a spark it is more difficult to ignite fuel oil vapors than gasoline vapors, (3) that there is a great difference in the rate of burning with fires soaked with fuel oil and with gasoline; (4) that a fire once started may under proper circumstances, be extinguished by pouring on a large quantity of fuel oil; (5) that in order to start a fire from a hot surface with either fuel, an accumulation of vapor around the surface is necessary It was concluded that the use of fuel oil considerably reduces the likelihood of ignition, except from a hot metal surface, and if ignition occurs, the intensity of the fire and its speed of development are both greatly reduced with "Diesel" oil

The "Diesel" oil used was "Domestic Furnace Oil" having the following characteristics: Initial boiling point —235 deg C, 5 per cent—262 deg C, 10 per cent—267 deg C, 20 per cent—275 deg C, 30 per cent—282 deg C, 40 per cent—286 deg C, 50 per cent—293 deg C, 60 per cent—299 deg C, 70 per cent—304 deg C, 80 per cent—314 deg C, 90 per cent—331 deg C End point—332 deg C, Recovery—92 cc, Residue—7cc, Distillation Loss—1cc, Flash point—158 deg F, Viscosity—56 sec. Saybolt at 100 deg F (approx.), Specific gravity —87.

The gasoline used was domestic aviation grade with a specific gravity of .71 and the following distillation test. 5 per cent—53 deg C, 50 per cent—82 deg C, 90 per cent—129 deg C, 95 per cent—152 deg C, End point—164 deg C

The lubricating oil was taken from the crankcase of an engine after about 30 hr running It originally had a viscosity of 115 sec Saybolt at 210 deg F and a flash point of 460 deg F

The "standard fire" used consisted of a piece of doped airplane fabric about 2 ft. square laid over two common bricks with five small sticks of spruce on top A can, in which was placed one pint of fuel, was arranged in such a manner that it could be upset over the wood and fabric by pulling a wire The set-up is pictured in Fig. 1

The first test made with this set-up used gasoline as a fuel and the ignition was accomplished by heating a short section of 2 in pipe to a cherry red and laying the pipe on the wood and fabric just before soaking with fuel The result was that the wood and fabric caught fire immediately before the fuel was poured on Fig. 2 shows fuel being poured on the fire. In order to prevent starting the wood and fabric before the fuel was dumped, test No 2 was made in the same manner except that a piece of thin sheet metal was placed on top of the pile and the pipe was laid on the sheet metal Fig 3 is a picture of the fire about five seconds after ignition With this set up approximately three seconds were required after the fuel was dumped before the flame started. In order to make sure that ignition did not occur as in test No 1, the hot pipe was laid on the sheet metal disc over a piece of wood and pressed down firmly in an attempt to heat the wood to the ignition point It was found impossible even to char the wood by this method and, therefore, it was concluded that ignition in test No 2 occurred from the gasoline coming in contact with the pipe In order to have further proof the pipe was laid on a piece of porcelain in test No 3 instead of on the sheet metal In this case, no ignition occurred. After the fuel had been poured over the fire, an electric spark was applied with results reported as No 4 in the summary Test No 3 was repeated in test No 6 and after two seconds from the time the fuel was poured on, ignition occurred thereby checking the results of test No 2 Test numbers 7 to 16 inclusive were run with the diesel oil as a fuel and ignition by the hot pipe, electric spark, or torch as noted in the summary It is noted that in

There is a wide-spread interest in the question of relative inflammability of Diesel oil and gasoline, and thus far there has not been sufficient experience with Diesel operation to provide any information on this subject. In an effort to obtain such data, Prof. C. Fayette Taylor and Edward S. Taylor devised and conducted the tests herein described.

tests both with fuel oil and gasoline, pouring the fuel over the pipe did not always result in ignition. Fig. 4 shows a diesel oil test which failed to ignite. In these tests the fire seemed to start underneath the hot pipe and not at the point where the fuel first came in contact with the pipe. This gave rise to the thought that perhaps it was necessary to confine some of the vapors around the hot pipe in order to obtain ignition. Test No. 15 was run with the hot pipe held in tongs in the air and the fuel oil poured over the outside surface. It was found impossible to get ignition by this method. However, when fuel was poured inside the pipe, ignition resulted immediately at every attempt. It should be noted here that there was a moderate wind blowing at the time the tests were conducted and the vapors were carried away very rapidly. The results of these tests might be somewhat different if there was no wind to carry away the vapors. Test No. 12 was run in an attempt to simulate the rapid combustion of a gasoline fire. The fuel oil was poured over the hot pipe in order to make a large quantity of vapor, and a spark was immediately applied to the vapors. Combustion resulted from this experiment, but there was no sudden explosion and the fire was quite slow and not at all similar to a gasoline fire. An idea of the relative speed of combustion may be had by comparing Fig. 3, a gasoline fire after five seconds, with Figs. 5, 6, and 7, a fuel oil fire after five, thirty and sixty seconds respectively. Fig. 8, which shows a fire of fabric and wood alone after sixty seconds, should also be noted. Test No. 17 was run with lubricating oil as a fuel and the results were somewhat the same as with fuel oil. The lubricating oil did not burn quite as readily as the lighter fuel oil. Tests No. 18 and No. 19 were run with gasoline to show that an accumulation of vapor was necessary with gasoline as well as with fuel oil, and the results of tests 18 and 19 are exactly similar to the results of tests No. 15 and No. 16 which were made with fuel oil. Tests Nos. 20, 21 and 22 were run in order to determine whether a fire already started could be put out by suddenly pouring on a large quantity of fuel oil. The result showed that it is possible if the fire is not too well started to put it out by dousing with fuel oil, but the quantity of oil required is large and it must be so directed at the fire as to smother it completely.

In general, the results of the tests showed that it seems to be quite as easy to ignite gasoline with a pipe at a cherry red heat as it is to ignite fuel oil or lubricating oil. The vapors of fuel oil poured on the hot surface seemed to be somewhat more difficult to ignite with a spark than the vapors of Aviation gasoline, and the starting of a crash fire from this cause less probable. Once the fire is started, there is, of course, considerable difference in the rate of burning between one soaked with fuel oil and one soaked with gasoline. In case of a crash where the occupants of the airplane were still conscious after hitting the ground, there would be considerably more chance of getting out before the airplane was completely consumed if the wreckage were drenched with fuel oil instead of gasoline. Fuel oil coming on top of a fire already started will put it out provided the quantity of fuel oil be very large compared to the fire and provided it be applied directly to the blaze in such a way as to smother it completely. Such conditions might conceivably apply in a crash where there was a small flame in the wreckage before oil from burst tanks was thrown over it.

While it is fully realized that these tests did not nearly duplicate the conditions of an airplane crash, it is felt that they furnish a qualitative indication of the relative fire hazard as between gasoline and furnace oil under similar conditions of test.

No attempt has been made here to investigate the relative probability, as between a Diesel power plant and a gasoline power plant, of a source of ignition being present in a crash. The tests were made merely to show the relative tendency to ignite from given ignition sources, and the relative progress of the fire after ignition. It seems safe to conclude from these tests that:

(a) Under conditions simulating a wrecked airplane soaked with fuel, the wreckage is more difficult to ignite when the fuel is Domestic Furnace oil than when it is gasoline, except where the source of ignition is a hot surface. In this case the ease of ignition seems to be about the same for both fuels.

(b) Under the conditions expressed in (a), when ignition does occur, the fire develops much more slowly, and the maximum intensity of the fire is much less in the case of the Domestic Furnace oil.

Summary of Fire Tests

Test One. This test, using gasoline as fuel, and with a standard fire set up (Fig. 1), was ignited by a hot pipe laid on wood. The time between soaking with fuel and first flame was practically zero, as was the time between the start of the fire and complete ignition. In this case the wood and fabric caught fire before the gasoline was dumped.

Test Two. This test used the same fuel and set up as the previous one but was ignited by a hot pipe placed on a thin sheet of metal. This gave a longer period between the soaking with fuel and the first flame, 3 sec., but once under way, complete inflammation was again instantaneous. The sheet of metal was placed between the pipe and the wood-fabric structure to avoid the latter catching fire.

Test Three. This test used gasoline as a fuel and a standard fire set-up, with a hot pipe insulated from the wood by porcelain. In this case there was no ignition of the fuel, wood or fabric.

Test Four. The same fuel and set up were used in this test as in test three, and an electric spark was used for ignition. As in test one, there was a zero period of time between soaking and first flame and between the start and complete ignition. The vapor ignited immediately from the spark.

Test Five. No fuel was used in this test and only the wood was exposed to a hot pipe. Between the pipe and the wood a thin sheet of metal was placed. No ignition occurred and it was found impossible to char the wood by pressing the hot pipe against the thin disc.

Test Six. This test was made under the same conditions as test three. In this case, ignition occurred two seconds after the soaking of the fuel and complete inflammation was instantaneous.

Test Seven. Diesel oil was used as a fuel for this test with a standard fire set up. A hot pipe, laid on porcelain, was used for ignition. The pipe was at dull red heat but no fire occurred.

Test Eight. With the same fuel and set up as in test seven, an electric spark was tried as a means of ignition. Again no flame resulted.

Test Nine. Again using Diesel oil and standard fire set up, a torch was used as ignition. In this case, the first flame appeared instantaneously and complete inflammation came thirty seconds later. An interesting note here was that the fire was not nearly so violent but persisted much longer than the gasoline flame.

Test Ten. In this test, the hot Diesel oil was poured over a hot pipe, lying on the ground. No wood or fabric were included in this test. This time the first flame appeared ten seconds after the start of pouring the oil and it was noted that the fire started from under the pipe.

Test Eleven. The fuel in this case was Diesel oil and the set-up was oil soaked earth. An electric spark easily ignited the vapors rising from the earth giving an instantaneous flame.

Test Twelve. With Diesel oil fuel and the standard fire set up, no ignition was noted with a hot pipe laid on porcelain. In this test, the oil might possibly have ignited from the pipe, had it not immediately been given a spark flash in an attempt to make rapid combustion similar to a gasoline fire.

Test Thirteen. Using the same fuel and set up as test twelve, with spark as ignition, a flame appeared instantaneously and thirty seconds later reached complete inflammation. There was no sudden explosion in this test.

Test Fourteen. This test, approximately the same as test ten, produced a flame five seconds after oil was poured on a hot pipe lying on the ground without wood or fabric.

Test Fifteen. Diesel oil poured over a hot pipe held horizontally in the air gave no ignition.

Test Sixteen. With a hot pipe held at about 45 degrees, the fuel poured inside, there was an immediate ignition every time the Diesel Oil hit the inside of the pipe. This was confirmed by repeating the test a number of times.

Test Seventeen. Using lubricating oil and a standard fire set up with ignition by a hot pipe, the first flame appeared five seconds and complete inflammation occurred in one minute's time. It was noted that the lubricating oil did not burn so readily as the fuel oil.

Test Eighteen. Gasoline poured over a hot pipe held horizontally produced no ignition.

Test Nineteen. This test, a duplicate of test sixteen, except for the use of gasoline as a fuel instead of Diesel oil, produced an instantaneous flame as the gasoline touched the pipe.

Test Twenty. In this test, a match was applied to the fabric of a standard fire set up, one minute before Diesel oil fuel was poured on. The fire was not extinguished by pouring on three pints of fuel oil, but burned much faster after the oil had been applied.

Test Twenty-one. Using a Diesel oil as fuel, and fabric only, a match was applied five seconds before pouring on the fuel. In this case, the fire was extinguished with difficulty by pouring on one quart of fuel oil.

Test Twenty two. Using Diesel oil as fuel and charred wood taken from a fire, the flames were easily extinguished by pouring on about one pint of fuel oil.

Test Twenty-Three. This test was made for photographic purposes only and used Diesel oil fuel with a standard fire set-up. A match was applied to a small piece of oil soaked fabric.

Test Twenty Four. Using no fuel a match was applied to a small piece of oil-soaked fabric and a standard fire set up, again for photographic purposes only.

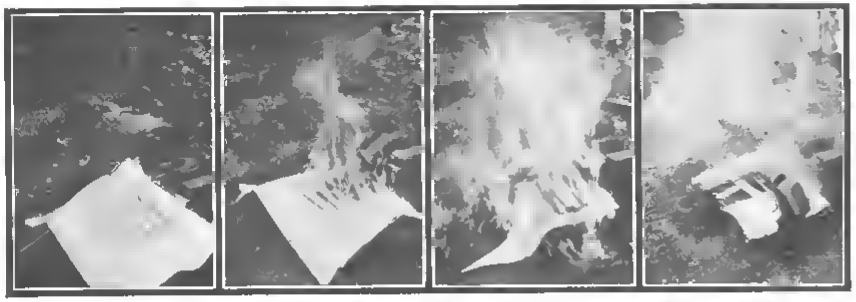


Fig. 1 Standard Fire

Fig. 2 Pouring Gasoline

Fig. 3 Five Seconds Later

Fig. 4 Diesel Fuel (No Ignition)

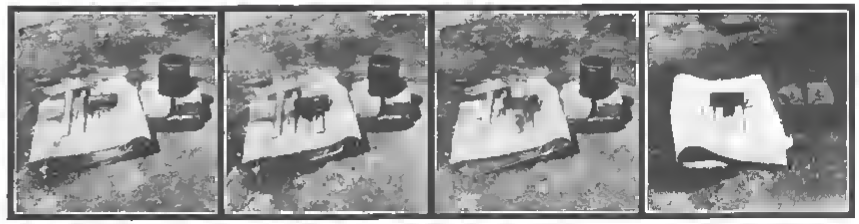


Fig. 5 Diesel Fuel (Five Seconds After Ignition)

Fig. 6 Diesel Fuel (Thirty Seconds After Ignition)

Fig. 7 Diesel Fuel (Sixty Seconds After Ignition)

Fig. 8 Fabric and Wood—No Oil or Gas (Sixty Seconds After Ignition)

AIR TRANSPORT DEVELOPMENT IN LATIN AMERICA

By H. Case Willcox
Foreign Dept. Pan American Airways

An authoritative account of air transport activities south of the United States, up to now often misrepresented or misunderstood

TRAVEL and postal communication between the Americas was extremely slow and therefore costly to commerce prior to 1920. The impetus given to aviation by the World War permitted air transport to be considered in the solution of this commercial problem. Europeans and North Americans began immediately after the Armistice, in various portions of Latin America, experimental ventures, many of which failed but all assisted in establishing and perfecting the expansion of the air systems which ultimately followed.

The first international airline out of the United States and in the direction of Latin America was the Aeromarine Airways, Inc., venture in 1919 between Key West, Fla., and Havana, Cuba. Colombia, Mexico, Peru, Bolivia and the Dominican Republic were the pioneer countries in commercial air transportation in Latin America.

After nine years of pioneering by French, German and American interests the Spring of 1928 found the North American financial groups in a receptive mood as to air transport projects in Latin America, and the United States Post Office Department advertised for proposals for the transport of mail by air over the Miami, Florida—San Juan, Porto Rico, route during May, 1928. This important step by the United States Government gave encouragement through governmental sanction and effectually solved the financial obstacles that had hitherto embarrassed and retarded the development of a co-ordinated system of air routes through the countries of Latin America.

The Pan American Airways System

COMMENCING during the latter part of 1928, and continuing on through to the present, survey amphibians bearing the significant Pan American Airways insignia roared southward from the eastern end of the West Indies over the Windward Islands, Leeward Islands, Trinidad and the Guianas. Brazil and on to the Argentine, southwesterly from Cuba through Yucatan, Honduras, Nicaragua, Costa Rica, Panama. The Canal Zone, down the Pacific coasts of Colombia, Ecuador, Peru, Chile, and across in blinding snow storms from Santiago, Chile, to Buenos Aires, Argentine, and Montevideo, Uruguay.

The Aviation Corporation of the Americas, Inc., of which the Pan American Airways, Inc., is the operating company, absorbed the New York, Rio and Buenos Aires Line, Inc., the Compañia Mexicana de Aviacion, S. A. of Mexico, the West Indian Aerial Express, C. por A., of the Dominican Republic, and with the aid of the W. R. Grace Company, formed the Pan American-Grace Airways, Inc. The Pan American Airways System is the holder of the U. S. Post Office Department Foreign Air Mail contracts numbers 4, 5, 6, 7, 8, 9, 10 and extensions which cover the transportation of air mail from the United States to Latin American countries. Pan American air routes now total 19,190 miles.

Routes 4 and 7 merge into one at San Salvador, El Salvador, and continue southward to the Canal Zone. Additional extensions contemplated to be placed in operation in the near future are the Venezuela-Trinidad and the Camaguey (Cuba)-Kingston (Jamaica), all under the auspices of the Pan American Airways, Inc., and completing two great circles of rapid transport with points of coincidence at Cristobal, Canal Zone, and Port of Spain, Trinidad. Study of the accompanying map shows the ingenuity of lay-out, which is such in flexibility that in case of rupture of operations at almost any point, traffic between North and South America could be rerouted.

During 1929 and up to Oct. 1, 1930, the Pan American Airways System lines were increased from 216 mi. to 19,190 mi. Pioneer companies' lines had been acquired and reconstructed and new routes had been placed in operation until on Sept. 1, 1930 the company's records showed 5,344,447 mi. had been flown, 30,727 passengers, 1,022,730 lb. of baggage and over 580 tons of air mail had been transported on the international routes with northernmost terminals in Brownsville, Texas, and Miami, Florida, and southern extremities at Montevideo, Uruguay, and Buenos Aires, Argentina, and in four different types of planes.

Corporación Aeronáutica de Transportes, S. A.

THIS company (Aeronautic Transportation Corporation) operates an air mail, passenger and express service southward from Nogales, Juarez and Matamoros on the Mexico-U. S. boundary over the table lands of Mexico to Mexico City, and a transcontinental air route between Matamoros and Mazatlán. The latter route was inaugurated on March 9, 1929, on a bi-weekly basis, and the Juárez and Nogales routes to Mexico were initiated on Aug. 17, 1929. The last mentioned routes have since been increased to a daily service between terminals within twelve hours. The itinerary and distances of the 2,087 miles flown are as follows:

Matamoros-Mazatlan Routes: Matamoros—Monterrey—Torreon—Durango—Mazatlán, 638 miles.

Juárez City Mexico City Route: Juarez—Chihuahua—Parral—Torreon—Zacatecas—Leon—Mexico City, 1,104 miles.

Nogales-Chihuahua Route: Nogales—Cananea—Macozari—Chihuahua, 345 miles.

Compañía Aéreo Hondureño

THE above company (Honduran Air Company), an air transport subsidiary of the United Fruit Company, was formed in the Republic of Honduras during 1928, and transports passengers, mail, and express over the Tela—San Pedro—Tegucigalpa route, a distance of 166 miles.

Isthmian Airways, Inc.

ISTHMIAN AIRWAYS, INC., inaugurated a tri-daily passenger and express air transport service on May 5, 1929, over the trans-Canal route in the Canal Zone and Panama. Charter flights were made to San Blas, Panama, and Cartegena, Colombia. On Dec. 31, 1929, the company reported that 89,000 mi. had been flown, and 4,111 passengers and 125,054 lb. of air express and baggage had been transported. The route flown is Cristobal, Canal Zone to Balboa, Canal Zone, a distance of 47 miles.

Scadta

THE Sociedad Colombo Alemana de Transportes Aereos in 1924 performed a large amount of aerial photographic mapping over unexplored areas of the Republic of Colombia. In 1929, the Scadta Company, under contract, performed for the National Governments of Colombia and Panama an aerial photographic survey for the purpose of delineating the Colombian-Panamanian frontiers. Other aerial surveys of importance were also performed.

Due to the fact that the original and main route of the Scadta company was located along the Magdalena river and later extensions were projected chiefly along the coasts of Colombia, seaplanes were selected as the flying equipment and to the present date still constitute the bulk of operation equipment. The passenger and mail routes being operated by the Scadta company, totaling 2,440 miles, at the present time are the following:

1. *The Magdalena line*, or Barranquilla—Girardot—Bogota (daily), 650 miles.
2. *Inter-Oceanic line*, or Barranquilla—Quibdó—Buenaventura—Tumaco (Colombia)—Guayaquil (Ecuador) (weekly), 1,200 miles.
3. *Atlantic Line*, or Santa Marta—Barranquilla—Cristobal (Canal Zone), 500 miles.
4. *Trans-Andean line*, or Bogota—Girardot—Ibague (bi-weekly), 90 miles.

Information secured directly from the company shows that, in 1929, a total of 781,000 mi. were flown by scheduled planes of the company, and a total of 5,500 passengers and of 134,400 lb. of mail transported.

Faucett Aviation Company

THE Faucett Aviation Company of Peru was originated in 1920. The individual, whose name the company bears today, carried on an air transport and photographic business almost single-handed until April, 1929, when a large North American aviation interest joined forces and enlarged the organization. This pioneer aviation company is entitled to great praise for its part in establishing air transport in Perú. Passengers, mail and express are transported over the following routes:

Arequipa — Mollendo — Iea — Lima — Chimbote—Trujillo—Pacasmayo—Chiclayo—Paita,—1,200 miles

Peruvian Naval Air Service

SERVICE was established in 1926 and opened up and connected the isolated portion of Perú lying to the east of the Andes, with the Pacific slope. An American Naval Air Mission sent to Peru played a large part in the establishment and operation of the service. Passengers, mail and express are transported over the following routes totaling 1,100 miles:

Puerto Bermúdez—Masisea—Contamana—Arellana—Requena—Iquitos, 800 miles

Moyabamba—Yurimaguas—Iquitos, 300 miles

Chilean National Air Lines

A PASSENGER, mail and express air service is maintained by the Chilean Government and is operated by the Chilean War Department. The frequency of service is three times a week between Arica and Puerto Montt and once a week to Magallanes. Three days' time elapses between the terminals. The following route is operated:

Arica—Iquique — Antofagasta — Copiapó—Ovalle — Coquimbo—Santiago—Puerto Montt—Puerto Aysan—Magallanes, 2,900 miles

Compañia Lloyd Aéreo Boliviano

THIS company was established in Aug., 1925, and at the present time operates a connecting air system of seven lines wholly within Bolivia, with headquarters at Cochabamba. Aerial photographic mapping is engaged in and passengers, mail, express and freight are transported. The circulars of information distributed by the company also mention that dogs, monkeys and large birds will be transported as freight and charged for by weight. The routes, totalling 2,264 miles, are operated:

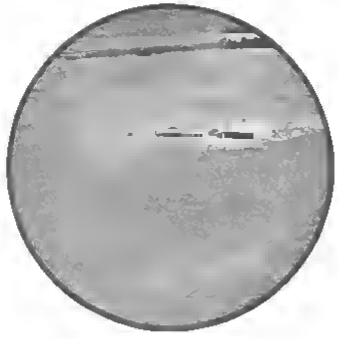
1	Cochabamba—Vallegrande—Santa Cruz	274 miles
2	Santa Cruz—Puerto Suárez	465 miles
3	Cochabamba—Sucre	150 miles
4	Santa Cruz—Yacuiba	375 miles
5	Cochabamba—Todos Santos	135 miles
6	Riberalta—Todos Santos	625 miles
7	Cochabamba—Oruro—La Paz	230 miles

Compagnie Generale Aeropostale (Latecoere)

TWO months before the World War Armistice or on Sept. 17, 1918, P. Latecoere presented to the French Government the first scheme for linking Europe, Africa and South America by air. As a result, the Latecoere Airlines were organized and commenced operations on Dec. 25, 1918. On April 21, 1921, the Compagnie Generale Aeropostale was organized under the laws of France and took over the Latecoere Airlines.

On Nov. 15, 1927, the Buenos Aires-Natal route was placed in operation and on March 1, 1928, the air mail was transported from Natal by fast steamers, by way of Fernando de Noronha Island, Cape Verde Islands to Daker, Senegal, thence by plane to Tangiers, Barcelona, Spain, Perfignan, Toulouse, Bordeaux to Paris, in a total of 17 days. This service has been improved until the Buenos Aires-Toulose trip is now made in 9 days, and from Toulouse to Buenos Aires in 7½ days.

Sao Paulo State Government Airport



Cie Aeropostale Airport at Porto Alegre

The operations of the company are conducted under its name between Buenos Aires and Natal and in Venezuela, while the S. A. Aeropostal Argentina is the operating subsidiary in Argentina. Passengers, mail and express are transported by these two companies over the following routes totaling 6,914 miles:

Under the Compagnie Generale Aeropostale (weekly)

Natal—Pernambuco—Maceio—Bahia—Victoria—Caravellas—Rio de Janeiro—Santos—Paranagua—Sao Francisco—Florianopolis—Porto Alegre—Pelotas—Montevideo—Buenos Aires, 2,895 miles

Maracaibo — Maracay — Ciudad Bolivar — Maturin (Venezuela), 689 miles

Under the S. A. Aeropostal Argentina

Buenos Aires—Mar del Plata, 240 miles

Buenos Aires—Bahia—Blanca—San Antonio—Oeste—Treles—Comodoro Rivadavia—Puerto Deseado—San Julian—Santa Cruz—Rio Gallegos (bi-weekly), 1,650 miles

Buenos Aires—Monte Caseros—Posadas—Asuncion (Paraguay) (bi-weekly), 690 miles.

Buenos Aires—Mendoza—Villa Mercedes—Rufino—Santiago de Chile (weekly), 750 miles

Sindicato Condor, Ltda.

THE Condor Syndicate, Ltd., was organized in May, 1924, by Capt. Fritz Hammer, Dr. Peter P. von Bauer and financial interests of Hamburg, Germany. The Company's purpose originally was to establish an airmail and passenger service from Colombia and the Canal Zone through Central America to the United States.

Two large Dornier Wal seaplanes were specially constructed in Italy for the use of this company. In August, 1925, the planes were flown from Baranquilla, Colombia, to the Canal Zone, and thence through Central America to Havana, Cuba. The flight was very successful from an operations viewpoint and was an outstanding pioneer achievement in the development of Latin America air transport. An attempt was made in New York to secure financial support for the intercontinental project of the Condor Syndicate, but it was several years in advance of the public's acceptance of international air transport.

The company then transferred its activities from the establishment of an inter-American air service to that of South American-European service, and particularly to the east coast of Southern Brazil. Experimental flights were made between Rio de Janeiro and Buenos Aires. A mail, passenger and express service was established in 1927 between Rio de Janeiro and Porto Alegre. The "Varig," or the Rio Grande Airways Company, is a subsidiary of the Condor and operates between Porto Alegre and Rio Grande do Sul. The lines were extended northward on Feb. 15, 1930, to Natal. On March 21, the air service was continued from Natal over water to the Island of Fernando de Noronha. At this point the mail is transferred to fast steamers bound for the Canary Islands, where it is transmitted to airplanes and flown to various points over the Lufthansa lines and other lines in Europe. The trans-Atlantic plane-steamer air mail service is provisional, as the schedule can only be fitted in to meet the steamer service. A further improvement contemplated is the replacing of steamer service by airships.

The Condor Syndicate, Ltd. reports that during 1929, 2,146 passengers, 44,447 lb. of baggage, 14,289 lb. of freight and 10,923 lb. of air mail were transported over its lines. The following lines making a total of 2,992 miles, are in operation:

Southern Division — Rio Grande do Sul—Pelotas—Porto Alegre—Santos—Rio de Janeiro (weekly), 935 miles

Northern Division — Rio de Janiero—Bahia—Natal—Fernando do Noronha Island (weekly), 1,511 miles

Bolivian Division — Rio de Janeiro — Corumba (Brazil) (weekly), 546 miles

Consolidated Table of Mileages

Company	Miles
Pan American Airways System	19,136
Corporación Aeronáutica de Transportes S. A.	2,857
Compañia Aérea Hondureña	160
Isthmian Airways, Inc.	47
Sociedad Colombo Alemana de Transportes Aéreos	3,446
Faucett Aviation Company	1,200
Peruvian Naval Air Service	2,000
Chilean National Air Lines	6,914
Condor Syndicate	5,652
Total Airways Mileage in Latin America	41,304

Additional companies in this field are the Cuban Curtiss National Aviation Co., the Central American Aviation Corp., Ltd., and the Caribbean Airways, Ltd., which are functioning in Cuba, Guatemala and Jamaica, respectively, on charter flights and flying schools. Only those companies that are operating at present on regular scheduled routes, which have been in operation for at least six months, are discussed in this article.

Radio Communication

MOST air lines in the Caribbean, Central America and the east coast of Brazil have excellent and increasing radiotelegraph facilities. The Pan American Airways System possesses its own radio communication system and has 48 ground stations in operation and 22 under consideration; over this network weather reports are flashed immediately and every plane always receives full information on the meteorological conditions along its scheduled routes. This comprehensive system constitutes a factor of safety corresponding to the block system on railroads. The safety factor is still further increased through the use of radio direction finding facilities which at present are in a semi-experimental stage. Equipment of this type is now employed in the most hazardous routes and has proved a very useful adjunct to the regular navigation instruments of the plane. As the direction finding equipment is perfected, its use will be extended over the other routes of the system.

Civil landing field at Sao Paulo

Contractual Relations

AIR TRANSPORT companies can be divided into national and international organizations. Sometimes the national companies are national in that they were formed and are owned locally in the country in which they operate. Other national companies are native of one country and are brought to another country, in which they operate, to secure a right to operate, which is termed a "concession," "operating permit" or "contract." Such an operation contract has a stated life of from one to twenty years and in republics must be approved by the legislative body, signed by the head of the department or ministry under which air transport functions, and by the Executive Power. It clearly covers what, how and when the company may transport and places it under the heading of a public utility. Nearly every Latin American republic has modern aviation laws, patterned after the best European and North American air legislation.

Mail is generally transported under a separate con-

tract, negotiated with the head of the ministry that handles postal matters, approved by the national legislative body and signed by the executive power The mode of payment of such a contract is necessarily on a poundage basis Exceptions to this procedure are the Condor Syndicate of Brazil, the Sociedad Colombo Alemana de Transportes Aéreos (Scadta) and its subsidiaries, of Colombia, which is a national company of that country, transporting mail to Panama and Ecuador, but which, under governmental sanction has, since 1921, sold distinctive company air mail stamps and operates a private air mail postal system throughout Colombia Scadta air mail stamps are sold at certain points in the United States of America and throughout the world and the use of the same has resulted in a great convenience to letter communication with the interior of Colombia

Air mail dispatched southward from the United States to various points in Latin America is transported under foreign air mail contracts let by the United States Post Office Department These contracts obligate the contractor to make available the space necessary to confine a specified maximum amount of air mail poundage and he receives payment by mileage flown One of the striking differences between domestic post office air mail contracts, within the United States, operating under the Watres Act, and the foreign air mail contracts, is the fact that the foreign air mail contractor is obligated at his own expense to negotiate right of way, maintain diplomatic relations, construct airports, establish and maintain radio communications and provide all modern safeguards throughout the routes contracted for

Both operation rights and mail contracts are granted to several different air transport companies by most Latin American countries and monopolies are unpopular due to the fact that the public has accepted air transport as a public utility and realizes that competition raises the standards of service, and that some companies offer advantages that others may not have, due to the fact that all do not operate through or connect with the same countries

Where operating contracts do not include a clause covering the establishment, maintenance and operation of radio facilities, special negotiations usually are required to secure the permit from the governmental authorities

Airport Facilities

Outside of the small number of airports that have been established by the war department of certain countries, the brunt of providing such facilities has fallen squarely on the commercial air transport companies Water operations have assisted somewhat in lessening the expense of such facilities Operations along the east coast of South America and in Colombia are chiefly confined to water landings, but in Mexico, Central America, the West Indies the West Coast of South America, Argentina and Venezuela, landing fields are either established or in the process of promotion or construction Of the two hundred or more airports in the Latin American Zone, seventy-two are owned or leased by the Pan American Airways System. An exceptionally modern and artistic airport is that of the Central Air Port in Mexico City, which will be officially inaugurated during December

Air Mail and Its Transport

Air mail is by far the most important subject of air transport, due to the income it furnishes and its benefits to commerce Canada and the United States are now connected by air mail services to the following countries and colonies of Latin America

Argentine	Curacao	Panama
Bahamas (Nassau)	Dominican Republic	Perú
Brazil	Dutch Guiana	Porto Rico
British Guiana	Ecuador	Salvador
British Honduras	Guatemala	Trinidad
Canal Zone	Haiti	Uruguay
Chile	Honduras	Venezuela
Colombia	Leeward Islands	Virgin Islands
Costa Rica	Mexico	Windward Islands
Cuba	Nicaragua	

The domestic air mail services of the United States and Canada are utilized to the extent available on outgoing and incoming air mail to and from nearly all of the above listed countries and colonies

Southward air mail passes out of Miami, Florida, and Brownsville, Texas, over four routes which eventually merge into three which in turn touch at every coastal country and colony of South America Seven days elapse between the departure of air mail from the larger cities in the United States and the arrival of the same in Buenos Aires, Montevideo, and Rio de Janeiro The same time is maintained by the northward service, from Buenos Aires and Montevideo, while the Rio de Janeiro-United States delivery is completed in six days The countries listed, with one or two exceptions, have the advantage of air mail service with all other countries mentioned Payment is made for the outgoing mail by the 29 countries and colonies mentioned on the poundage basis

The Scadta maintains an air mail service between Colombia, Panama, Ecuador and Perú, supplemented with steamship service to the United States and various other companies As the Scadta is the only commercial air transport company operating in the interior of Colombia, the advantage of its service is the great time saving value to foreign commercial houses

The Condor Syndicate transports mail between Bolivia and the long coastal regions of Brazil, and flies such mail as is destined for Europe to the Island of Fernando do Noronha

Aeropostale maintains an air mail service between Argentina and Brazil and at Natal, Brazil, dispatches mail to Dakar, Africa, by boat for transshipment by air to Europe An interior air mail service is maintained within Venezuela which is proposed shortly to be connected with Trinidad, the Guianas and Natal, Brazil

The Lloyd Aéreo Boliviano maintains an air mail service between the interior cities of Bolivia and exchanges traffic at Puerto Suarez and Yacuiba for dispatch over other air lines to the east, north and south The Faucett Aviation Company in Peru and the Chilean National Air Lines in Chile are purely national transport systems and carry air mail within their respective countries

It is interesting to note that a letter passing over the international air lines between New York and one of the great South American cities is flown 8,000 mi in seven days, and crosses over 15 international frontiers, peoples speaking six different languages and topographic changes in the earth's surface between sea level and 18,000 ft above

The foregoing completely summarizes the field of air transport companies in Latin America. Eleven independent aviation companies, possessing over 41,000 mi of airways, operating on a scale of approximately 10,000,000 mi per annum, are the outgrowth and result of the first ten years of Latin American aerial transport activities, bringing to a close the romantic pioneer period

THE STORY OF WICHITA

This article is the second of a series of three dealing with the interesting aeronautical history of this mid-western city which has produced approximately one-fourth of the commercial airplanes manufactured within the United States. The third article is scheduled for an early issue.

By John T. Nevill

Detroit Editor of Aviation

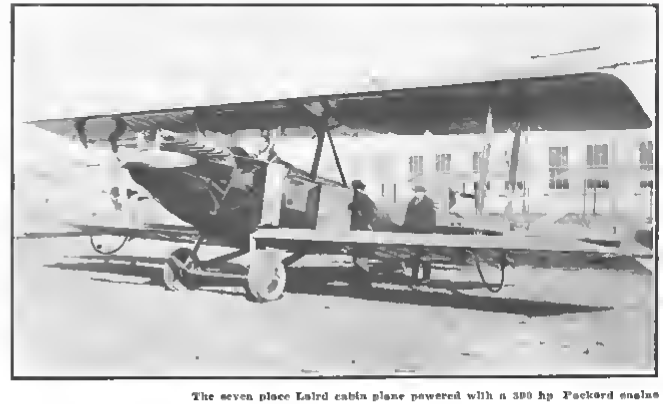
The Wichita Airplane Company, that city's "foothold" on the aircraft industry, had a slippery beginning As outlined in Part One (Aviation, September) it had been organized during the "dog-days" of 1919 by a group of ex-army pilots and financed by a group of local enthusiasts including one Jacob Melvin Moellendeck

Difficulties of one sort or another beset it *ab initio*, with the result that the company did not live out that first year However, that company might well be termed the "key-log" in the movement that was to follow, and here is how it evolved

It will be recalled that in Part One we left Matty Laird in Chicago manufacturing the two-place, Gnome powered sport plane known as the Laird Model S, and that Williams A (Billy) Burke was making his headquarters in Okmulgee, Okla, operating what he called "The National Exhibition Flyers" It will also be recalled that at that time Buck Weaver was barnstorming with Charles W. Meyers, but later, early in 1920, went in with C J Bruckner and E. J Junkin in forming the Weaver Aircraft Company at Loraine, O

Scarcely had the two Canucks and the Jenny, the company's total flying equipment, been given their baptism of civil service, before Jake Moellendeck decided the company needed a new manager Moellendeck remembered his days in Okmulgee, and sent for Billy Burke One of Burke's first managerial duties and, incidentally one of his last was to look over some prospective new equipment That was late in 1919, and Chicago was staging its first aero show So Burke went to Chicago to cast an appraising eye over the field

The show held, among others, a three-place Avro and a Curtiss Oriole, both of which looked good to the Wichita man But Laird was then designing a three-place job and insisted that Burke hear about it Now, Matty had an advantage over the Avro and the Oriole in that Burke, in his erstwhile capacity of manager, secretary and treasurer, book-keeper, and chief pilot of



The seven place Laird cabin plane powered with a 300 hp Packard engine

National Exhibition Flyers, had used one of Laird's Gnome-engined biplanes, and liked it.

At any rate, in showing Burke his blueprints, Matty waxed exceedingly generous and offered his friend exclusive sales rights throughout the United States. Burke was enthusiastic over the forthcoming model, and showed it. But his contact with the manufacturing end of the business had given him a grand idea. His proposition ran something like this:

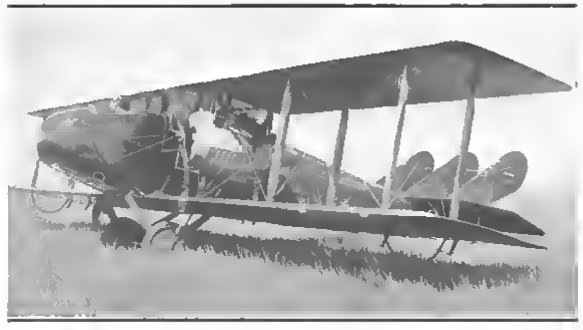
"Look here, Matty. You can design and manufacture airplanes. That's all you need. I have a little money, and Jake Moellendeck down in Wichita has money, so why don't we three form a partnership and put these things out in worth-while quantities. Wichita has a red letter day on right now. Oil is spouting from those wells down there and making people drunk with prosperity. It's selling for $3.50 per barrel and most of that money is staying right in Wichita. Those folks need airplanes, whether they know it or not, and we might as well sell 'em to 'em. . . . What do you say?"

So, at the close of the Chicago show, Matty Laird went into Wichita. Conditions there seemed about as Burke had pictured them. Business was good. Banks and individuals were loaning plenty of money. People were making it, and people were spending it. Everything seemed in order for an auspicious beginning.

A three-way partnership was formed. Burke put up $15,000. Moellendeck put up $15,000. And Laird put up his designs, his equipment, his material and his experience. Thus the E. M. Laird Company, of Chicago, reorganized, and became the E. M. Laird Company, of Wichita. The mid-plains city has gained another step in advance of its aeronautical threshold.

The E. M. Laird Company of Wichita set up temporary headquarters in some rather limited shop space found behind the old Wichita Forum. The Watkins Manufacturing Company, owners of the building, turned the structure over to Laird and his backers, rent-free, on condition that the Laird company purchase some woodworking equipment which was already installed therein.

Considering the times, and also considering the fact that some of the sub-assembly work had been completed in Chicago, it did not take the company long to turn out job number one. But again we are ahead of our story.



Matty Laird in the cockpit of the twin engined Laird biplane

In the meantime, in December, 1919, to be precise, another occurrence of importance took place. The Wichita Airplane Co. had begun to give ominous signs of an early demise. The company was badly in debt, and the stockholders were rapidly growing doubtful on the idea of selling air transportation, either in the form of a utility or of a thrill, to the general public. So the E. M. Laird Company purchased the insolvent company—field, hangars, ships, and all—for $19,000. Meanwhile the company continued to build its planes in the downtown shop.

It should be mentioned here that the original working capital of $30,000 invested in the company by Moellendeck and Burke did not long suffice, especially after the Laird organization had absorbed Wichita Airplane Company. Moellendeck, from time to time, added more of his own cash, choosing also to give his friends an opportunity to "get in the business." It is said in Wichita that Moellendeck, who was president of the company, eventually had as much as $300,000 in the investment.

The first ship to be completed by Laird in Wichita was carted to the flying field for tests in April, 1920. Following the usual final field assembly, Matty Laird clambered into the cockpit, someone else spun the prop and the craft's resplendent OX-5 began to purr. During the engine warming process a handful of employees and a small group of stockholders stood as close as safety would permit, admiring what has come to be termed "America's first commercial airplane."

What those onlookers saw was a three place, open, tandem cockpit biplane, powered by a 90-hp. Curtiss OX-5 engine. Both upper and lower wings, which were constructed in four bays, aside from the center bay, which was 30 in. wide, had a span of 36 ft. and a chord of 58 inches. Over-all length was 23 ft. 4 in. and over-all height 8 ft. 8 in. Both wings gave the plane an area, including ailerons, of 324 sq. ft. They had a stagger of 10 in., were set at one degree dihedral, and employed an R.A.F. 15 airfoil section.

The upper and lower panels were interchangeable and there was a gap between them of 58 in. Ribs were of grooved spruce battens, screwed to basswood webs lightened between the spars. Spars were built of two routed out laminations, the two sections glued to form a box spar. Number 8 hard wire was used for internal bracing. The lower engine casting was cowled in with six rows of lateral slots affording ventilation through the metal. The front, or passengers' cockpit, was of the side-by-side type, and was carpeted for comfort and appearance. The conventional V-type landing chassis, steel tubing, was attached to the fuselage by four bolts extending parallel with the longerons. At the wheels they were spaced by two steel tubing tie rods front and rear of the axle. The axle, incidentally, was of the long since abandoned horizontal type, and was 1½ in. in diameter, with a ⅛-in. wall. All landing chassis members were faired. Like nearly everything else of its time, it had a wooden framed fuselage, braced with wire. A standard stick and cable control system was employed.

While the spectators on that Wichita field were still eyeing and admiring their creation, from its rounded nose to its rakish tail, Matty Laird "gave it the gun" and took off on its baptismal flight. Bill Lassen, Wichita hotel man, was among those on the scene, and he was entranced.

"There she goes, boys," he exclaimed, "just like a swallow."

Thus the fifth distinct type of airplane designed and constructed by Matty Laird was christened "The Swallow," and the name has remained as a household word in the industry to this day.

Test flights on the first Laird Swallow, conducted by both Laird and Burke, were of such a pleasing nature that it was decided to begin immediately on a 10 ship production program. This necessitated additional help, and therefore we introduced another personality behind Wichita's "Big Four." Among the help recruited by the Laird organization during the summer of 1920 was a wide-awake and energetic young fellow named Lloyd Carlton Stearman. Lloyd Carlton Stearman was born in Harper, Kans., about 30 years ago, and educated in the public schools of the Sunflower state. He was a student of architecture at Kansas State Agricultural College when the United States entered the World War. Naval aviation lured him, so some months later he was enrolled in the ground school at the University of Washington, Seattle. Following graduation from ground school he was sent to the naval station at San Diego, Calif., for preliminary flight training. He was still a fledgling when the Armistice was signed, and he was returned to civil life. Back in Wichita he accepted a position atop a high stool in an architect's office, which vocation he left to join the assembly and rigging department of the newly-born Swallow factory. Subsequently, of course, he did some drafting, and eventually became chief drafting engineer, but all that came later. Among others placed on the payroll at about that time, it might be noted, were Walter (Pop) Strobel, later with Travel Air, and now with Cessna; Bill Snook, still with Travel Air, and Waverley Stearman, Lloyd's brother. It might also be mentioned that Matty Laird's original Chicago personnel, most of whom were transferred to Wichita, included C. L. Laird, Matty's brother; Lester F. Bishop, now with the United States Department of Commerce, and Walter Weber.

During 1919 and 1920, if you recall, the country was flooded with a lot of pilots released by the military and naval organizations, and they had very little to fly, except for the ubiquitous Jenny dumped on the commercial market by the government. Manufacturers of any good airplane of two or three place capacity, of equal horsepower, lighter, cleaner, and more manageable than the Jenny had a splendid, although limited market, in these erstwhile "war birds." So it was that a considerable number of these men heard of the Laird Swallow, saw it, and liked it.

Orders, Mr. Laird avers, came in so fast that "everybody went wild." The planning department, which is another way of saying Jake Moellendeck, opened up the production throttle just as he would the main valve on one of his wells. Meanwhile, Moellendeck was backing his voting strength with more money—and still more money. Production jumped to one plane per month. Then to two per month. Then to three per month. And then to four per month, which was pretty fair production for a strictly commercial company at that time.

Eight hours a day became ten, then twelve, and then more. Employees, straining in their harness, began to grumble, but carried on. The company's other executives, including Laird, disapproved of the president's policies, and protested, but it availed them little. Supply must keep pace with demand was Moellendeck's creed. And he was faithful to that creed—even though at a rather tremendous cost to himself.

In the Fall of 1920, during this tumultuous time, it became apparent that the company needed someone to take care of field and demonstration work. And Matty Laird decided Buck Weaver was the logical man for that job. Although Weaver, several months before, had teamed up with Messrs. Bruckner and Junkin in Weaver Aircraft at Lorain, Matty experienced little difficulty in prevailing upon his *fidus Achates* to join him in Wichita. It seemed that Weaver Aircraft was not enjoying the same rush of business found by the Swallow company. Weaver had begun business by designing and building what they pleased to call a "Ford of the air," although, eventually, this Lilliputian landaulet became generally known by the more undignified name of "Cootie."

The Cootie was a parasol type monoplane with a plywood fuselage and powered by a 2 cylinder opposed Lawrence engine. Weaver Aircraft built it in 1920 as the "flyver of the air," but they seem to have been at least 10 years too early, which undoubtedly accounts for their market being practically nil. At any rate, Weaver went to Wichita, leaving Bruckner and Junkin, who moved shop to Medina, Ohio, and later—in 1922—to

Two of the original Waco biplanes powered with the OX-5 engine

Troy, Ohio, where Advance Aircraft (now Waco Aircraft) was organized and still holds forth. (Prior to Weaver's leaving, however, Weaver, Bruckner and Junkin built a plywood fuselage biplane powered by the same engine. This model was succeeded by an OX-powered Waco 5, a comparatively primitive forerunner of the Waco of today.)

THE year 1921 brought a number of rather important changes to the little Wichita company. One of them was the employment of Walter H. Beech, a move significant to the industry ever since. Following the World War, during which he served his aerial apprenticeship under rigorous taskmasters at Rich Field, Waco, Texas, Walter Beech had done some barnstorming in Standards and Jennies around Arkansas City, Kas., and elsewhere. It was in May, 1921, that Moellendeck gave him a job as test pilot and demonstrator at the Laird factory. Matty Laird and Buck Weaver had taken off about a month previously for the West Coast, where they hoped to establish dealers.

During this period the young company made one of those costly run-steps that practically all companies make occasionally in the interest of experimentation. At a decided injury to production of marketable Laird Swallows, the company designed and built a "white elephant" in the form of a 7-place cabin biplane, equipped with two OX-5 engines. This dual engined sky-wagon flaunted three rudders, set well above a one-piece elevator and she had a prow on her like the forepart of a whale. The pilot sat in an open cockpit in the prow, forward of a passengers' compartment that would do justice to the DO-X. About the best that can be said for this plane is that it was a commendable early effort toward achievements in cabin plane design that followed.

The Laird Swallow Matty and Buck had flown to San Francisco was sold on the coast, and Weaver returned to Wichita in time to help Beech test fly the cabin job. One of the principal "bugs" in the big ship was vibration imposed by the engines. It was decided to re-vamp the job into a single-motored craft of equal passenger capacity but of smaller proportions. Col. Charles Dickinson, airmens' financial "angel," of Chicago, who always has been in close touch with the Laird activities, had several 300-hp. Packard engines, so Laird purchased one of them to supplant the two OX-5's. However, some time later, Beech found it difficult to obtain practical amounts of the proper fuel for this high compression engine, so he took it out and tried a Liberty. While installing the Liberty he installed an expansion tank for cooling purposes in the leading edge of the radiator.

Apparently the new installation was faultily vented, for shortly afterward, just as it was taking off en route to Bartlesville, Okla., the expansion tank exploded and the pilot "squashed in," reducing the plane to little more than a pitiful pile of splintered wood and torn fabric.

In the business depression of the Fall of 1921 Billy Burke was compelled to take three ships as his share of the assets and withdraw from the company. Returning to Okmulgee he devoted most of his time to rejuvenating a badly crippled automobile business, and flying whenever opportunity permitted. Not many years ago he was killed while stunting over a lake in his home state.

As an indirect result of friction created by Moellendeck's employment of Beech, a feeling superinduced while members of the Laird organization were attending the 1921 Pulitzer races in Omaha, Moellendeck let Weaver go at the close of that year. Weaver returned East, but later returned to Chicago, where he, too, passed away a few years back.

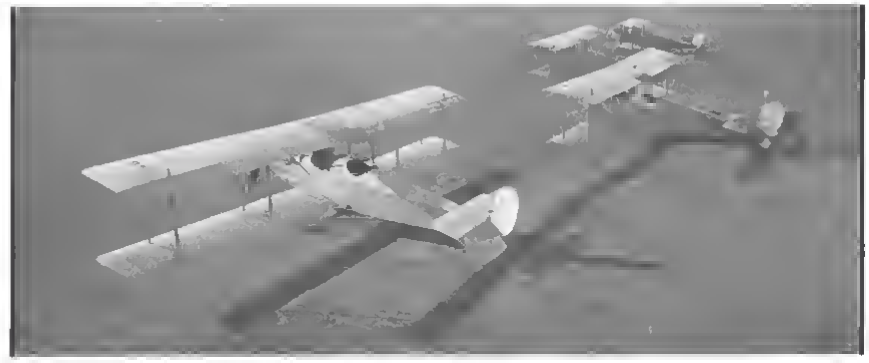
Throughout the years 1922 and 1923 the E. M. Laird Company, under Jake Moellendeck's open pursed, but tight-gripped rule, continued operation. But during the latter half of 1923, after production of approximately 43 Laird Swallows, Laird and Moellendeck arrived at open disagreement as to policy, and Matty decided to give up. In October of that year he accepted two airplanes and $1,500 in cash as the purchase price of his holdings, and left Wichita. Once back in Chicago he organized the present E. M. Laird Airplane Company.

Following Matty Laird's departure the Wichita company was reorganized as the Swallow Airplane Manufacturing Company, with Moellendeck, C. L. Laird, Beech, Stearman, Strobel, Snook, and Waverley Stearman as principal members of the personnel. Beech became the *major-domo* of all field work, and Lloyd Stearman was promoted to chief designing engineer. In his capacity it fell upon Lloyd Stearman to design the New Swallow, a 3-place, open-cockpit, single-bay, biplane, powered by an OX5, said to be the first commercial airplane of its type in America to have an engine completely enclosed and streamlined.

Matty Laird in front of his "Baby Biplane" powered with a 4 cylinder Hofer engine

DURING the spring and summer of 1924 Walter Beech continued with the New Swallow the work he had started in 1922 with the Laird Swallow, that of piloting it at competitive air meets in various parts of the country. Noteworthy among these events was the Admiral Fullam Derby, held in July, of that year, at St. Louis, in which Beech flew a New Swallow to victory.

However, during two days of the following October Wichita herself, basked in the nation's aeronautical sunlight by holding the National Air Congress, a field meet that drew civilian and army pilots from all parts of the



Four of the early Laird Swallows ready to take the air

country. "To handle this huge affair," said a writer in *The Wichita Magazine*, official organ of the Wichita Chamber of Commerce, "there was formed a Wichita Chapter of the National Aeronautic Association, with 500 members, with L. S. Seymour as president, J. H. Turner, Jake Moellendeck and Walter Beech, vice-presidents, C. M. Casey, secretary and general manager, Frank Russell treasurer, and A. W. Hinkel, Woody Hockaday, L. C. Kelly, Henry J. Allen, J. H. Engstrom, Walter Innes, Jr., Marcellus M. Murdock, Hal Black, and A. E. Merriam as directors. To underwrite the affair a guarantee fund of $20,000 was secured from Wichita business men through the efforts of these men and it is interesting to note that the guarantors were called upon for a small amount, mainly because thousands of people saw the show without paying admission."

The Air Congress, too large for any flying field then available, was held on a particular flat mile square of land south of town and known as the "California section." This property, today, is Wichita's new "million dollar" municipal airport, and the interesting manner it was acquired for that purpose will be told later.

For purposes of comparison it should be worth while here to sketch hastily some of the other developments that were taking place in other sections of the United States contemporaneous with the activities in Wichita. It is needless, of course, to state that the commercial airplane of late 1924 was most remarkably in advance of the commercial plane of 1920, which year we are using arbitrarily as the beginning of commercial development in America. Strides were taken toward reducing the weight-power ratio in engines. Design of the craft proper was "cleaned up," reducing weight and increasing performance capabilities to such an extent that one found it hard to believe that 4 years could bring that difference. (The period, 1925-1930, no doubt, has witnessed a much greater advance in both plane and motor, but we are speaking as of late 1924.) Airfoil efficiency, the L/D ratio, fuselage streamlining, strut-tairing, and many other "tricks of the trade" were improved upon and added their bit to increase performance and simplify design.

Workmanship, itself, was bettered, the airplane taking off its overalls to don its Sunday suit.

The Army and Navy, and other governmental agencies, through the building of racing planes and the development of powerful, high-performance military craft, as well as by endless research work, contributed a goodly share of that knowledge. Independent manufacturers, however, were beginning to appear here and there, and they, also, were doing research work, although on a more modest scale. The Postoffice Department was carrying the mails from coast to coast, demonstrating one peace time utility of the airplane. The youth of the nation was becoming eager. Capital was just beginning to be interested. Governmental legislative bodies were investigating and submitting reports. The entire country was just awakening to the dawn of the unbelievable five-year era we have just witnessed.

PROBABLY the greatest advance, in so far as structure is concerned, occurring during the 1920-24 period, was the introduction of metal into fuselage and wing construction. As early as 1922 William B. Stout, in Detroit, had built this country's first all-metal airplane, a torpedo plane for the Navy. This particular development involved, principally, the use of sheet aluminum. Light alloys of tubular section, a development that has influenced design immensely, were first introduced in fuselage structure by none other than Matty Laird early in 1924. Laird, in fact, employed a metal framed fuselage on the very first plane he built after leaving Wichita. In the meantime, the Army had accepted as standard practice the welded-steel tube fuselage first developed in Europe by Fokker.

We have stressed this latter point because it has much to do with the next trend in this particular story, a step which happened to occur shortly after the National Air Congress in Wichita. Toward the close of 1924 the question of using metal or wood to frame the New Swallow fuselage became a bitter issue in the Swallow factory. Mr. Beech and Mr. Stearman were strongly in favor of adopting metal. Mr. Moellendeck did not agree with them. This dispute led to the resignation of the two non-stockholders, and to the formation of Travel Air. Travel Air's development and the development growing out of Travel Air will be told in Part 3.

Shop Notes and Technical Data

MULTI-ENGINED PLANE PERFORMANCE WITH ONE ENGINE DEAD

By Edward P. Warner
Editor of AVIATION

THE battle of the single versus the multiple engine has been fought out over the past ten years on the issue of the real ability of the multi-engined ship to lose one power plant and still continue in flight. It has been thoroughly proven that certain two engined and three-engined airplanes with their normal pay load on board can cut one switch and still gain altitude. There has been a long series of depressing experiences to demonstrate that others were quite unable to do so. The operator seeking a plane for specific conditions and wanting to insure safety in forced landings has often been reduced to guesswork or dependence upon the unsupported, and sometimes unsupportable, claims of manufacturers.

The ability to spare one engine involves so many elements of power and of control that an absolute determination can be made only in a flight test but it does not require a flight test to show that claims are sometimes presented that are wholly unreasonable. A simple theoretical connection can be found between the simplest elements of performance with full power and the probable behavior with power reduced. The writer has evolved a formula to cover the case, and has put it to the test to which all airplane performance formulas should be submitted—comparison with flight test results on existing machines.

The proportion of reserve power determines whether or not flight can be continued with one engine dead. The proportion of reserve power determines also the absolute ceiling of the plane with full power. The implication that there ought to be a connection between absolute ceiling and performance with power reduced is obvious. Furthermore there is a practical reason for looking to the absolute ceiling as the basic factor, for the obvious condition of flight with one engine gone at sea level is that the absolute ceiling under that condition should exceed zero feet. Similarly, a machine that is to be employed on a transcontinental route and still be independent of engine failure at all points along its course must have a ceiling, minus one engine, of at least six or eight or ten thousand feet, depending on the route selected.

The writer and various other students of the subject have independently developed, a number of years ago, the formula for absolute ceiling

$$H = 40\,000 \log_{10}\left(\frac{P_a}{P_r}\right)$$

where H is the ceiling, P_a the maximum power available at sea level, P_r the minimum power required for level flight at sea level. If the cutting out of one engine had no effect on flying qualities except for reducing power available, the formula for ceiling with full and reduced power, respectively, could be written

$$H_1 = 40\,000 \log_{10}\left(\frac{P_a}{P_r}\right)$$

$$H_2 = 40{,}000 \log_{10}\left(\frac{P_{a_2}}{P_{r_2}}\right)$$

with the subscript 1 denoting the full power condition and the subscript 2 the power with one engine gone. Combining the two, we should have

$$H_1 - H_2 = 40\,000 \left[\log_{10}\left(\frac{P_a}{P_r}\right) - \log_{10}\left(\frac{P_{a_2}}{P_{r_2}}\right)\right]$$

The minimum required powers would be the same in the two cases, and

$$H_1 - H_2 = 40{,}000 \log_{10}\left(\frac{P_{a_1}}{P_{a_2}}\right) = 40\,000 \log_{10}\left(\frac{n}{n-1}\right)$$

n being the number of engines.

With two, three, and four engines the ratio would become 2, 3/2, 4/3, respectively, and the calculated differences of ceiling for full power and reduced power would be 12,040, 7,040, and 5,000 ft., respectively.

Since there is nothing whatever that would improve the general efficiency of the airplane with one engine cut off as compared with that running at full power, and several factors that act in the opposite direction these differences of ceiling are absolute minima, and the manufacturer who admits that his heavily loaded twin-engined machine has an absolute ceiling of only 14,000 ft., and yet claims that it is able to fly to a height of 3,000 ft. with full load and one engine dead, claims the absolutely impossible.

The principal factors making things still worse than they appear on the surface are two—increased resistance due to the necessity of carrying the rudder at an angle to balance the offset thrust with the wing engine dead, and decreased propeller efficiency. The first point of course is a commonplace, recognized by every pilot with any experience on multi engined planes. Some machines in fact have had power enough to hold them at a constant altitude, but have been unable to adhere to a straight course with one engine cut, even with full opposite rudder, and it has been necessary to throttle down the opposite wing engine in order to go anywhere. The second point, the effect of propeller efficiency, is not so generally appreciated, but is of distinct importance. Propellers are commonly designed for maximum performance at cruising speed with full power. With one engine cut the speed has to be considerably reduced in order to remain in flight at all, and the propeller efficiency goes down. The use of a variable pitch propeller would in many cases increase the ceiling with one engine cut by from 1,000 to 2,500 ft., and would increase by just that much the altitude of the ground over which the machine could safely pass without risking a forced landing in case of an engine failure.

It is somewhat difficult to calculate these effects accurately, but a trial may be made for the three-engined machine as the commonest multi engined case. The effect of cutting out one engine on such a machine is to lower the efficiency of the remaining propellers at their new cruising speed by about four per cent which in itself would lower the ceiling by about 700 ft. beyond the minimum theoretical amount already calculated.

Furthermore, there is the question of additional resistance due to the use of the rudder, of course assuming that there is enough directional control to hold a straight course against the unbalanced thrust.

To cut out one wing engine on a three-engined machine leaves one-half the remaining thrust acting at a distance of some 10 ft. off the center line of the plane in a typical case. The resultant moment has to be counteracted by a side pressure on the rudder, which, again in a typical tri-engined transport, would be about 30 ft. behind the center of gravity. The lateral force needed on the rudder and fin would then be about one-sixth of the total thrust, and the drag of the vertical tail surface would be increased by approximately one-fifth of that amount, or about one thirtieth of the total resistance of the plane.

This alone would be bad enough, but in practice the case is even worse, for the lateral force on the rudder compels the machine to travel at an angle of yaw in order to hold a straight course, "crabbing" through the air with a lateral pressure on the opposite side of the fuselage. In case the right wing engine cuts out, in other words, left rudder must be used to hold a straight course, and the machine then slides through the air with the right wing advanced and with an air pressure against the right side of the body. Although it is almost impossible to generalize on the effect of yaw on fuselage resistance, it is in all cases considerable. Furthermore, this lateral force on the fuselage is centered behind the center of gravity, and creates a small turning moment opposed to that given by the rudder, so that even more rudder must be used than the simple calculations heretofore made would indicate. All these things together should on the average approximately double the increase of drag, raising it to about one fifteenth of the thrust and so increasing the power required for flight at the reduced cruising speed by a like fraction. That change would lower the ceiling by another 1,200 ft. The total difference between the ceiling of a three-engined machine with full power and with one engine cut off would then appear in theory to be 7,000 + 700 + 1,200, or 8,900 ft. It remains only to compare this theoretical value with those actually observed.

Manufacturers both in America and in several European countries, and the Army Air Corps as well, have been generous in providing data on the tests that have been made although measurements of absolute ceiling with one engine completely cut have been rather infrequent. In trials on half a dozen distinct tri-engined types, including externally braced monoplanes, cantilever monoplanes, and biplanes, both landplanes and flying boats, the loss of absolute ceiling with one engine cut has been found to range from 5,500 ft. to 13,300 ft. Both of those points, however, were obvious freaks. Eliminating them, and one other low figure of questionable accuracy, the difference in every case lies between 7,400 and 11,000 ft., with an average of 8,300 ft.—a value differing from the theoretical one by only seven per cent. The theoretical figure, incidentally, had been completely calculated before these observed values were tabulated, so there was no distortion of the assumptions to make the two harmonize.

In the interest of economy of space the theoretical calculation will not be repeated here for a twin engined machine. It shows a ceiling loss of 14,900 ft., as against an average of 15,000 among the four machines on which test data were to be had. Again a very satisfactory check. A similar calculation for a four engined plane with one engine cut out gives 6,100 ft. as the ceiling loss.

It may be objected that these figures will not apply to engines in tandem or to the case of the failure of a center engine on a three-engined machine. So far as the tandem arrangement is concerned, the loss in propeller efficiency due to cutting out one engine is usually great enough so that the net result on flight capacity is almost as serious as in the case of a wing engine. The other point is, of course, perfectly valid, and in general the loss of a center engine on a three-engined machine is much less serious than the failure of one of the wing power plants. The figures that have been given apply, as they should, to the worst cases.

In recapitulation, the average effect of cutting out one engine on machines with several power plants of equal capacity is to lower the absolute ceiling by approximately 15,000, 8,500, and 6,000 ft., respectively, on two, three, and four-engined machines. The application to design and operation is obvious. Calculate the maximum ceiling required for safe operation over the highest point of the route to be flown, assume that that is to be maintained with one engine dead, add the figure of safety factor just given and then design or select the airplane for an absolute ceiling, with full power, at least up to the resultant total.

EFFICIENCY IN THE SERVICE ORGANIZATION

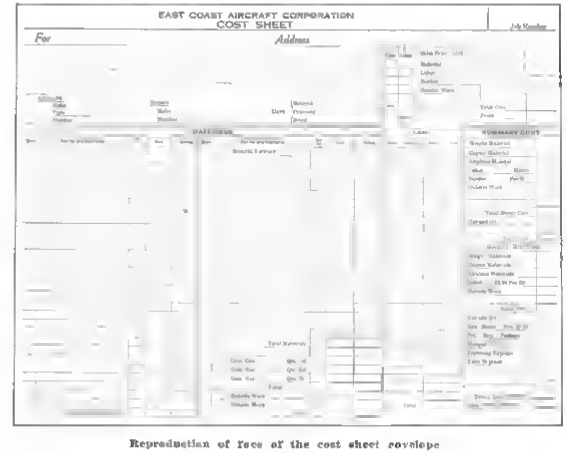
By F. L. Ames
President, East Coast Aircraft Corp.

EARLY in 1929 the organizers of the East Coast Aircraft Corporation felt that the aviation industry was reaching the stage where a strictly sales and service organization would find a definite place for itself. As in this article I intend to discuss only the service of modern aircraft and engines, we shall make no further mention of the sales aspect.

The building in which this business is housed includes, first a two story office section containing seven large offices and space devoted to switchboard and waiting room. Adjacent to the waiting room is a large showroom comparing favorably with an automotive showroom, capable of containing two biplanes of standard dimensions. This portion of the building faces upon the field. Back of this comes the hangar—dimensions 100 ft. x 80 ft.—and in the rear of the hangar, as far as possible from the field and the dust, is the shop. The shop is divided into two departments, the engine department, and upstairs in a balcony over the hangar, the accessory department.

Executive personnel consists of a president a vice president and treasurer, the latter chosen not for his knowledge of the aircraft business, but for his knowledge of finance and business in general.

The key man in the maintenance department is the manager. Therefore, H. E. Wallis, a man of over twenty one years' experience in the aircraft busi-



Reproduction of face of the cost sheet envelope

ness, holds the position Under his direction were chosen the foremen of the various departments With the system used in this company the service division is sub-divided into two separate departments, one the hangar, which has its own foreman, its own definite crew and its own time-clock, and then the shop, which has a similar set up

The members of the hangar crew are chosen largely for their experience with aircraft in the field On the other hand, a fair proportion of the shop personnel have had no aircraft experience whatsoever before joining the company. On the face of it, it appears necessary with an aircraft overhaul shop to use only factory trained men. However, we have attempted in our shop to break down the steps in an overhaul to a series of highly specialized operations

In the stockroom, where is kept a complete stock of parts for the various Wright engines, special tools and fittings required for the handling of the engines and rough stock, such as electric cable, bar stock, sheet metal, etc., the standard card indexed perpetual inventory system is used Any stock drawn from the stockroom is drawn on a requisition installed by either the hangar or the shop foreman and made out in triplicate. One is handed in to the stockroom and is filed by the stockrom clerk, the other goes in the "customer's cost envelope," which will be described subsequently and the third is sent to the shop office, where it is filed and at the end of the day there is compiled the amount and value of stock issued. The material credits are handled by the same system, using credit sheets in the reverse order In the case of tools the regular tool check system is used

When a new job comes in, regardless of its nature, it receives a number and the customer's name and address, and all information relative to the job is entered on the "customer's authorization and production order sheet." This sheet is made up in quadruplicate The original, signed by the customer, is filed in the shop office The next one is placed in the 'cost sheet envelope" The third one goes to the hangar foreman and the fourth to the shop foreman, according to the nature of the job

The cost sheet envelope is a large envelope in which are placed—besides the material requisitions and the production orders—all other outside billings relative to that job Then on the outside of the envelope the materials are itemized, and from the various job cards the time used on that job is set down All labor, materials and other items are set down on the cost sheet on the outside of the envelope. On this cost sheet is found the summary of the entire job, the individual sheets of which are contained within

As thorough inspection is one of the most important operations in an engine overhaul, very complete inspection sheets are used for all operations of the engine These sheets, including the test run sheet, number fourteen

The Overhaul Procedure

To give a clear picture of the procedure it might be well to describe a typical overhaul. This is divided into several logical steps If the engine is flown in, the first step is removal from plane Then the engine is placed on its stand, and is checked for accessories received It is then rolled into the shop and the shop foreman signs the hangar foreman's release

The engine is then rolled into the dis assembly and cleaning room where it is completely torn down even to the small assemblies such as oil pump, gas pump, etc Here the carburetor and magnetoes are removed and sent up to the carburetor and magneto shop where they are dis-assembled as units Each portion of the engine as dis-assembled is cleaned in gasolene spray bath and then such parts as should require it are cleaned by boiling in a caustic soda solution After removal from this bath they are neutralized by a dipping into dilute acid and then rinsed The complete dis assembled engine is then placed on a four deck rolling stand and moved into the inspection room Here every wearing part is measured by micrometers and gauges and results of these measurements entered upon the various inspection sheets covering these parts All other parts are minutely inspected for crystallization and incipient cracks, and where necessary, this inspection is augmented by etching and the use of a duplex microscope In the magneto and carburetor department these accessories after tear down are inspected in the same manner

Then the engine is sent back to the shop with the various orders and all portions are re-conditioned to the required factory tolerances Re-conditioned parts again return to the inpsection department where they receive a second searching inspection The engine again goes to the shop for final assembly Assembly is done as far as possible upon a small assembly line and it is executed in the several logical steps Then the engine is given a complete exterior inspection prior to test After passing this inspection it is placed on the test stand which incidentally is modeled directly after the standard factory stands and completely enclosed in a portion of the shop building

The final acceptance test is divided into two parts First comes the run-in If there has been a large number of replacements, the engine is first run in by electric power If not, it is started immediately and is run for four heurs at gradually increasing speed starting at 600 r.p.m Then for the first half hour of the last hour of the run it is run at ¾ full throttle and the last half hour full throttle. During this last hour of run the gas and oil consumption is noted every ten minutes As four blade calibrated test propellers are used, the engine at full throttle should turn at the speed specified by the manufacturer and therefore should be developing its rate horsepower After the last half hour is completed there is then made an idling test and acceleration test and finally a test for best setting of the mixture control and the economy of the engine should meet the manufacturer's specification.

At the completion of the test run the engine is removed from stand and is given what might be termed a super-inspected 15 hour check If it passes this successfully it is then pushed into the hangar where the hangar foreman signs a release for it. Upon reaching the hangar it is installed in the plane and receives the final installation inspection It is then run on the ground with its own propeller and carefully observed for its performance The final step is its air test which is generally performed by a flying mechanic If it passes all these satisfactorily, the customer than takes delivery

As far as the line service is concerned an attempt has been made likewise to systematize this work as far as possible It is obviously impossible to achieve as high a degree of efficiency in this branch as in the shop, for the simple reason that the work permits a far lesser degree of standardization and specialization It has been found expedient, however to detail certain men, as far as possible, to nothing but the work of the so-called fifteen hour check. As these men do the same thing day after day, notwithstanding the problems of different installations, etc, they become extremely proficient and the man hours which one of these checks entail has been reduced materially,

All hoe work is directly in charge of the hangar foreman and he is responsible for getting the job out in time, properly done It has been found that the most satisfactory results with these checks are obtained by the use of check sheets which cover every operation in detail, thus the human element of fallibility is removed to as great a degree as possible, although the majority of the shop work is done on a flat rate basis. Up to date it has been found impracticable to offer flat rates on these checks as different installations, condition of engines and other such details cause large variance in man hours among individual jobs

The daily inspection as required by the Department of Commerce has been covered by check sheets in the same manner and in passing it may be noted that this daily check before flight is included as a free service with the storage charge to transients This policy has proved very successful as in a great number of cases a careful check will reveal small necessary adjustments which the customer is glad to authorize, and hence this added service more than pays for itself.

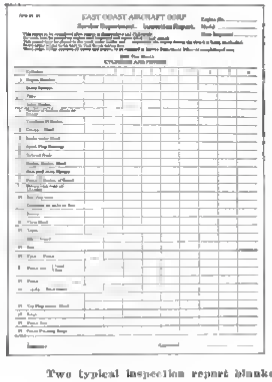
The problem of quick, efficient and economical service in the field has been covered by training those mechanics who show the most natural attitude for clear reasoning into specialized trouble shooters At present there are three field service men, two of whom are L. C. pilots In case of a field service job, the nature of the job is ascertained and the service man is dispatched with the necessary tools and parts by truck or by plane, depending upon the location of the job If it is possible to fly to this job—it is always done, as this entails no extra expense to the customer At first sight this may appear to be somewhat paradoxical but the facts are as follows

From the time the service leaves the shop the customer is charged at the standard rate of two dollars and a half an hour. If the man leaves by truck the customer is also charged the truck mileage, by plane, the same procedure is followed with the meidental higher mileage charge, but it has been found in practically all cases that the saving in the man hour charge offsets the added mileage charge for flying, so that the final charges work out practically the same.

As an additional service to customers who are enjoying prosperous operations and therefore cannot afford to lay up their planes during engine overhaul, the company offers its so-called service engines for hire These engines are rented on a hourly flying basis

The maintenance department of East Coast Aircraft Corp is also equipped to service propellers, carburetors, magnetos, instruments, starters and other devices A complete stock of the necessary replacement parts is always available.

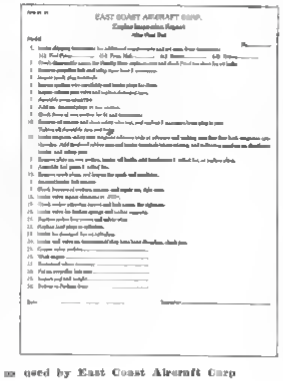
It has been discovered that in any territory where on the face of it there may appear to be insufficient business for a highly specialized service organization, that the business is really there but latent For example, before the instrument division was opened, there was apparently no need for such a service whatsoever. However, subsequent to its opening it appeared that a great majority of planes had been flying for some time with one or more instruments out of commission.



EAST COAST AIRCRAFT CORP.

Service Department. Inspection Report.

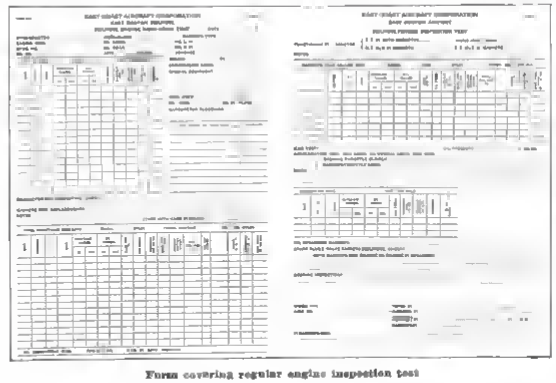
CYLINDERS AND PISTONS



EAST COAST AIRCRAFT CORP.

Engine Inspection Report

Two typical inspection report blanks as used by East Coast Aircraft Corp



Form covering regular engine inspection test

NEW PROPELLER CONSTRUCTION METHODS

By Lieut. L. D. Webb

U. S. Navy, Bureau of Aeronautics

RECENT propeller development has as its incentive the desirability of reducing the weight of present propeller assemblies and the possibility of improving both strength and efficiency This effort has taken two logical but decidedly divergent paths One method seeks to reduce weight and centrifugal stress through the employment of lighter alloys the other accomplishes the same result with hollow blade construction fabricated from high strength alloy steel

The alloys of magnesium offer considerable promise in the reduction of propeller weights as the specific gravity of the material is about 1 80 as compared to 2.80 for the present aluminum alloy blades The magoesium alloy which now appears best suited for propeller use consists of approximately 96 6 per cent magnesium 4 per cent aluminum and 0 4 per cent manganese This alloy has demonstrated an ultimate strength varying from 38.000-40 000 lb sq in in the forged condition The elongation under these conditions is from 15 to 20 per cent and the alloy has a fatigue limit for propeller use of about 11,000 lb sq in

Several experimental propellers of this material are now under construction at the plant of the Hamilton Standard Propeller Co for the Bureau of Aeronautics of the Navy Department and when completed will be used in extensive service tests to establish definitely the advantages or disadvantages of the material for propeller service. A propeller of this type designed for the 225 hp Wright Whirlwind engine, weighs 52 lb complete with hub A similar aluminum alloy propeller assembly for the same engine using alloy blades and a steel hub weights 78 lb

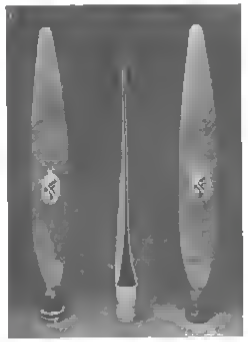
The experimental blades of this design were produced from billets which were alloyed, cast and heat treated They were then machined all over and subjected to X-ray inspection Following the inspection the sound billets were extruded to a diameter slightly greater than the largest shoulder on the end of

the blade. They were then re extruded to a form from which the blade sections could be pressed and the end of the extruded blank was left in the press to form the shoulder at the hub After extruding, various portions of the blades were pressed out in a series of operations to form a rough blank from which the propeller blade could be machined These blanks were then roughed to size on a special type of dupheating machine and finished by grinding and polishing

The magnesium alloy propellers have so far been made for a new type of hub for which the inner ends of the blades are made hollow resulting in a semi-hollow propeller, combining the advantage of the solid forged blade with the saving in weight possible with a hollow inner portion

This hub is made up of a spider which fits onto the engine shaft and which is provided with two tapered extensions A taper of one in six is used as it has been found that this taper gives a very tight drive, but will not seize The inner ends of the blades are provided with a conically tapered bore, which fits accurately on the taper of the hub extensions This provides for the drive of the propeller and the centrifugal force is taken by a short split hub member which extends beyond the two shoulders The blades and hubs are machined so as to give a shrink fit of about 003 in on the tapers The propellers may be assembled by heating the ends of the blades in boiling water so that they go together freely and draw up tight on cooling, or they may be assembled by tapping the ends of the blades to drive them up onto the ends of the taper

Governmental air services require that all radically new propeller designs be thoroughly proven by "whirl testing" prior to actual approval of the design for flight purposes A sample magnesium alloy propeller of the type described herein was accordingly subjected to the whirl test, and after successfully passing the minimum requirement of ten hours at 450 hp was successively tested by one hour runs at 100 hp, increasing the power until 1200 hp was reached. It was then run for 10 hr each, at 900, 1,000, and 1,200 hp without failure It was finally run one hour each, at 1300, 1400, 1500 and 1600 hp At the end of the 1600 hp run a small crack had appeared in one blade which had its origin in a dent caused by a mechanical injury This would have led to failure in further running and the test was therefore discontinued. As a result of this test it may be said that the magnesium alloy blades of this particular design have ample strength to withstand any normal centrifugal stresses



Left: Completed hollow steel blade for standard hub Center: hollow blade sectioned longitudinally Right: Hollow steel blade for Navy 400 lb. test

All steel propeller, made by Dicks Aeronautical Corp

Although the whirl test with its strenuous loading, can probably be accepted as adequate proof of propeller strength, a new design involving a change in material is usually run on an engine test stand for a considerable period before using it in flight. The object of this phase of the test is to establish that the propeller will withstand successfully the widely varying streases encountered with certain "rough running" engines. There have been numerous instances where a propeller has passed a whirl test at high loading and a similar blade has failed in the course of an engine test conducted at a far lower output Failures of this nature are due to fatigue conditions in the metal, developed by rough running

The magnesium alloys are particularly susceptible to corrosion due to salt spray but are not greatly affected by alkalies or acid fumes The spray corrosion is greatly improved by immersing the blades for ten minutes in a neutral solution of magnesium phosphate at a temperature of about 120 deg. Fahr This produces a substantial protective coating to which a Duco lacquer will adhere satisfactorily These protective measures will doubtless render propellers of this material entirely satisfactory for general use on landplanes but their suitability for seaplane service will depend upon the ability of the protective coatings to withstand the action of water spray which during the take off strikes the propeller blade with such force as to cause small pits to form in the metal on the leading edge, near the propeller tips If no corrective measures are taken these pits are rapidly enlarged by erosion and by the corrosive action of salt water. This condition has been extremely troublesome in aluminum alloy propellers and unless the protective coatings are unusually effective will doubtless also be difficult with magnesium alloy blades

Strength of propellers is the principal problem of the designer The trend toward higher engine powers and increased engine speeds in the past few years has emphasized the necessity for a propeller material of greater strength and fatigue resistance than that of the aluminum alloys now in general use Already we have seen very substantial increases in the root diameters and an accompanying increase in the weight of solid aluminum alloy blades used on engines of high output

On account of the stresses present in a propeller blade revolving at high speed and the increased efficiency to be gained through the use of thin air-foil sections, it is evident that the distribution of the metal in a blade is often as important as the quantity of material used The need for a high strength hollow blade is therefore apparent and the governmental air services accordingly are encouraging the development of hollow steel propellers

Two widely different types of hollow steel blades have completed an entirely satisfactory whirl test similar to that described in the discussion of magnesium blades One of these types has had an appreciable amount of satisfactory flight testing The other is now in the process of exhaustive engine stand and flight tests A third type is under development at the plant of a large manufacturing corporation

All of these hollow steel blades are fabricated from high strength alloy steels one type using a chrome vanadium S A E. No 6130 steel, another a chrome molybdenum steel The ultimate tensile strength and the fatigue limit of propeller blades built of these materials are of the order of 100,000 and 50,000 lb per sq in respectively, as compared with the corresponding values of 55,000 and 12,500 lb per sq in respectively for aluminum alloy blades Since the material can be placed where it is most needed, the weight handicap due to the use of steel can be readily overcome and present experimental hollow steel propellers in this respect compare favorably with standard aluminum alloy blades even when the steel blades are used with the standard type of hub now in general service. One of the great weight saving features of the hollow steel type of propeller construction is the fact that radically new hub designs weighing far less than the present standard types may be used without sacrificing strength The weight reduction of this character which is already in sight will range from 20 to 50 lb on propellers of varied service sizes

It is hoped, and confidently expected, that the hollow steel type of blade construction will to a large extent eliminate the troublesome pitting and erosion now encountered in seaplane service with aluminum alloy blades. Spray tests conducted some time ago by the Bureau of Aeronautics with various materials inserted in the leading edge of alloy blades indicated that the alloy steels had the best spray resisting qualities of the materials tested. Flight tests of the hollow steel blades under severe seaplane operating conditions are now in progress and will be continued for an indefinite period

One of the pronounced flight characteristics of these steel blades is their resistance to torsional vibration, which in a periodic form results in "propeller flutter" These blades possess marked superiority in torsional rigidity as compared with aluminum alloy blades and the result is a very smooth running propeller

The use of hollow steel construction for propeller blades is not particularly new, as a metal propeller of this character was produced some years ago by a British aeronautical engineering company European methods of construction did not appeal to American engineers, however, and accordingly after considerable experimental and research work new methods of fabricating hollow steel blades were successfully developed at home

One method as developed under the Dicks patents by the Pittsburgh Screw & Bolt Corp, employs a two-piece construction in which the flat and cambered faces of the blades are cut from chrome vanadium steel sheets of the correct thickness and are shaped to the correct contour and angles in dies built for the purpose The two sections are then welded together to form the complete blade The welding process is ingenious and the joints are so made that the seams do not come on either the leading or trailing edges of the blade No weld is in tension and the blade root is formed from the inner ends of the sections. Subsequent operations bring the blade to its finish dimensions and the hub end is machined to fit the type of hub with which the blade is intended to be used It is finally chromium plated and polished This type of construction results in the production of a blade which has exactly the same shape from hub to tip as the aluminum alloy blades now used as a standard In addition due to the stiffness of the blade near the tip as compared with the alloy blade there is less distortion of the blade when in flight and a comparison of the overall efficiencies of the two blades is favorable to the hollow steel type

Another type of hollow steel construction, developed by Air Propellers, Inc., of Hagerstown, Md., eliminates the welded seam and forms the complete propeller blade from a seamless steel tube. The further development of this typ of blade construction is in the hands of the Hamilton Standard Co, of Pittsburgh, Pa A tube of the proper dimensions is first cold drawn and is then swaged to the required variation in diameter with length A flange is then upset at the hub end of the blade, following which the tube is annealed and then expanded to the correct contour It is then machined to obtain the correct wall thickness, the tip end is closed and the blade is heated and shaped to final contour between dies. The final operations consist of heat treatment and chromium plating

The seamless tube process described above results in a lighter blade than the two piece method but in this case the blade contour and plan form near the hub end of the blade are somewhat different from the standard blades now in use. This is necessarily due to the process of fabrication and will probably not effect the efficiency of the blade to any appreciable extent This latter question is now in the process of determination by service flight tests

Through the advent of the hollow steel propeller it is possible that in future airplane designs the engine exhaust will be dissipated to the atmosphere by leading the gases into a collector ring and thence into the hollow blades near the hub, and finally allow them to escape to the atmosphere through a series of small openings cut in the trailing edge of the blade from mid radius to the tip A sample installation of this nature has been tested by the Bureau of Aeronautics and while a failure of the collector ring assembly terminated the test before all the desired information was obtained, the results were sufficiently conclusive to indicate clearly that a properly designed exhaust system of this character would improve engine performance because of more efficient cylinder scavenging and better cooling In addition the device was the most effective muffler tested to date The normal staccato noise of the engine exhaust was practically eliminated and all that could be heard was the sound of the propeller slipstream passing through the set up This feature if it proves to be entirely practical may be of great interest for use with night flying transport aircraft. The basic ideas involved in the device are not new and are covered by numerous patents issued to various individuals It still remains to perfect the mechanical features of the design before final conclusions can be reached concerning its practicability

As the size of propellers increase, such as in dirigible power plant installations and large geared engines in airplanes the need for light weight propeller blade construction become increasingly apparent. Propellers for these installations may reach a diameter of sixteen feet and with the solid type blade construction the centrifugal and other unit stresses become excessive unless the blade root, the sections of the blade and the hub are increased in area and weight to a considerable extent The use of hollow steel blades for installations of this nature is a possible solution which may simplify design problems and result in increased safety and durability.

A further application is found in controllable pitch propeller designs as lighter and stronger blades having less distortion in flight will simplify the bearing problem at the blade end, the point where so many controllable pitch designs have given trouble in the past due to incipient or actual bearing failures

All things considered, the development of the various designs of hollow steel propeller blades into the production stage deserves considerable attention and emphasis The research stage has been completed, the development stage is nearly finished and it only remains to get the blades into general service to prove their real merit. The obvious advantages of either design discussed herein are many and their disadvantages few in comparison with earlier developments in aircraft propeller engineering

New Equipment

A TEN PLACE STINSON

THE Stinson Airliner powered with three 210 hp Lycoming engines has been granted Approved Type Certificate No 335 and is now under production by the Stinson Aircraft Corp of Wayne, Mich. The plane has a span of 60 ft., and a gross weight of 8,500 lb It is the type now being used on the recently established Ludington line between New York and Washington

The entire structure of the Airliner is of metal, fabric covered. Metal cowling is used on the engine nacelles and the center engine compartment back to, and under, the pilot's cockpit The fuselage is made up completely of welded Air Corps specification chrome-molybdenum steel tubing, no brace wiring being used Welded steel tube wing spars, truss type, are employed Ribs are of square duralumin tubing and the wing has a metal leading edge

All control surfaces are of conventional construction. Elevators and ailerons are operated by means of push-pull tubes, which may be readily inspected. The rudder controls are of the cable type and the cables are run through separate tube housings

The cabin is provided with a large door, the sill of which is close enough to

the ground to do away with the necessity of steps Upholstered arm chairs are provided for the passengers and there is ample isle room. The chairs are spaced 38 in apart The cabin floor is covered with a removable carpet.

Thrust lines of the three engines lie in the same horizontal plane The exhaust stack from the center engine collector ring runs back to the rear of the cabin and the nacelle engine exhaust is released through the outer side of each nacelle in order to decrease the exhaust noise reaching the cabin Each engine unit is removable by taking out four bolts and disconnecting the control and fuel lines. Interchangeable oil tanks are mounted directly on the engine mounts

Bendix wheels and brakes are standard and Aerol struts are used both for the landing gear and tail wheel shock units. Specifications are as follows

Gross weight fully loaded	9 500 lb
Weight empty	5 460 lb
Useful load	4 040 lb
Pay load	1,050 lb
Span	60 ft
Height	10 ft. 4 in
Length	36 ft. 10 in
Wing chord	105 in
Wing area	480 sq ft.

The Sikorsky S-41 Amphibian powered with 2 Hornet engines

back as the cabin, the remainder being covered with fabric

Welded steel tubing and channel section members are employed in the construction of the empennage units, the channel members being used for the rear spars of the stabilizer and vertical fin.

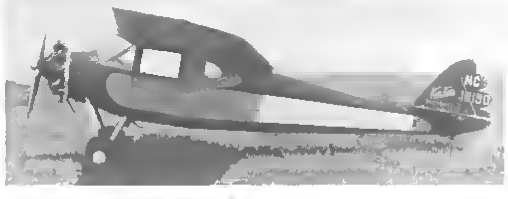
Divided axle landing gear having a tread of 6 ft 6 in. is employed with Oildraulic shock struts and 26 in. by 4 in wheels as standard equipment. A rigid spring steel tail skid with detachable shoe is also used.

The gasoline tank which has a capacity of 18 gal., is built into the lead edge of the center section. Behind this is a Pyralin window providing visibility above and to the rear

Side by side seating is employed in the cabin which has ample space for two persons without crowding Windshield and side windows, which lower into the body, are of laminated glass Dual detachable stick and rudder pedals are of course provided and the interior appointments in general follow automotive practice very closely A baggage compartment in the rear has ample capacity for two Gladstone bags All controls, including the rudder are operated by steel tubes

The specifications as furnished by the manufacturer are as follows

Length overall	55 ft. 5 in.
Wing span	80 ft.
Wing area	1462 sq ft.
Weight empty	9560 lb.
Gross weight	15300 lb
Useful load	5800 lb



The Lambert powered Kari-Keen '90

KARI-KEEN "90" MONOPLANE

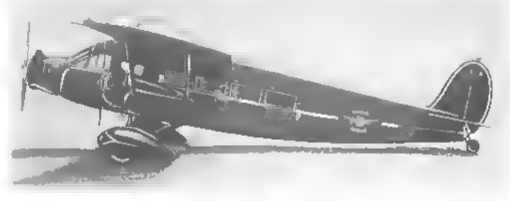
DESIGNED primarily for flying instruction and private use, the Kari-Keen "90" has been granted Approved Type Certificate No 531 and is now being manufactured by Kari-Keen Aircraft Inc, Sioux City, Iowa This plane is an entirely new product of the company and was designed by the firm of Gazley & Lasha. It is powered with the Lambert five cylinder 90 hp engine

The Kari-Keen "90" has a wing span of 30 ft. and a gross weight of 1530 lb. The monoplane wing is tapered in plan form, having elliptical tips and is built in two panels of wood construction. The center section is a part of the fuselage and is constructed of welded steel tubing The fuselage is built in the form of a Pratt Truss and has an integral engine mounting It is cowled with aluminum sheet as far

THE SIKORSKY S-41 AMPHIBION

SEATING nine to fourteen people, in addition to a crew of two, and powered with two Pratt and Whitney Hornet engines, of 575 hp each, a new Sikorsky S-41 has recently been placed in service by Pan American Airways

The hull of the S 41 is of metal construction, covered with Alclad sheets and has been designed with a two step bottom The hull is divided into five water tight compartments and entrance



The 10 place Stinson, powered with 9 Lycoming engines

is obtained through a hatch in the roof and a swivel staircase in the cabin The pontoons are metal and interchangeable Each pontoon is divided into three water-tight compartments

The wing is of conventional Sikorsky construction, using open duralumin cross sections, covered with fabric. The wing consists of three panels and has a dihedral angle of 1½ deg.

The landing gear and general arrangements of this plane follow conventional Sikorsky practice, as exemplified in the S-38. Specifications of the S-41 are as follows:

Weight empty	7,500 lb
Useful load	5,000 lb
Gross weight	12,500 lb
Span	78 ft. 10 in.
Length overall	45 ft 3 in.
Height	15 ft. 6½ in.
Wing area	720 sq.ft.

What Our Readers Say

A Plane for Commuting

TO THE EDITOR

Representing hundreds of laymen with whom I have discussed aviation matters I want to congratulate AVIATION upon the everyone will fly" attitude which your magazine has taken and especially this September issue Articles such as those in this issue by Warner, Bowen, Stout, Osborne, Castle, Ingals and others are rendering a very great service not only to aviation but to humanity in general Common everyday people are already 'Motor Minded" and they have also become "Air Minded"

There is something decidedly wrong with the aviation business when a person can go to a half dozen or more of the leading manufacturers and have them look him over with astonishment when he says he wants to buy a plane that will take him from his business offices in Chicago each night 120 miles across Lake Michigan home and return him in the morning again in time for work In every case the result of the inquiry was unsatisfactory with such remarks as these "We don't believe we have anything satisfactory for this purpose or the price of the machine such as you would want is probably out of your reach or you know you would have to pay $600 for 10 hours dual and 10 hours solo instruction, etc"

In one case the editor of a prominent magazine volunteered the information that he would be very glad to arrange for some of the companies to show their machines and if necessary demonstrate them provided the applicant would advance $1 000 to insure his good faith, etc. whatever that may mean It would seem as though the aviation business could draw some lessons from the automobile business It was not many years ago that the automobile was regarded as a thing for the rich only Now there is an auto for every family The same thing is bound to be true regarding flying machines and I am certain that the time is right here when a great change is due in aviation What is needed is a plane that will cost them some $600 to $2 500 varying according to the needs of the individual person and that will travel 90 to 100 miles an hour that anybody can drive who can drive an automobile and that lands on either earth or water and that will accomodate one to two or three people.

Congratulating you upon the attitude which your magazine has taken in this business of "aviation for everyone" I remain,

P. G HOLDEN,
International Harvester Co
Chicago Ill

•

The National Air Races

TO THE EDITOR

I have read with much interest your critique dealing with the 1930 National Air Races, as published in the October issue of AVIATION magazine, and heartily agree with your stand on all but three phases of the race meet

Although you concede that the triangular race course, as laid out at Chicago, was of very satisfactory form, I feel that it is possible to greatly improve upon the present form of airplane race courses from the standpoint of interest to spectators in the geandstands It is my idea that various types of courses should be experimented with, particularly those having one very obtuse angle, and that every effort should be made to give the spectators a full view of the racers along every leg of the course, even if it means taking the pylon from its position directly in front of the stands I think that some advantage might be found for a course in which the base of the triangle extends directly past the grandstands with a pylon some distance away at each end of the stands and the third pylon directly in front of the stands but possibly not more than one-half mile away This would eliminate the close ups of home pylon brushes, but would bring all three pylons fairly close in to the stands and would provide the spectators with a good view of every leg of the course This type of course would keep spectators interested in maneuvers on all three pylons and on all three legs of the course whereas at present their interest is concentrated almost entirely upon what happens on the home pylon and during periods when no planes are approaching or rounding that pylon the interest in the race subsides noticeably

Again, in the matter of the length of races, it was my reaction to the Chicago events that the longer races were most appreciated by the audience and I should think that with sufficient racers to keep a five mile course busy that no race should be less than fifty miles in length even for the slower planes Even where one plane is much faster than the others, if the race is continued for fifty miles or more around a course as short as five miles there is soon quite a bit of passing

It has been my observation that it is the passing of one contestant by another which most thrills the average spectator It is probably too much to expect that air races will ever be perfected to the point where the spectator will be able to tell who is running first, second and third merely by watching the race We must depend upon the scoreboard, so conspicuous by its absence at Chicago, for our position results lap by lap, and upon long races around short courses to hold the interest of the spectators Even though the race may degenerate into a parade, if there are enough entrants to make the affair interesting most spectators would like to see the race prolonged to at least fifty miles just to see whether the leader may not grow careless and crash have engine trouble, or otherwise be forced down or out

The third point to which I wish to draw attention, is the number of starters It seems to me that if we could have at least ten starters in every race that we would materially increase popular interest There was certainly no appreciable interest in those events at Chicago where only three to five planes competed at least there was no popular interest Members of the industry get quite a thrill out of watching only two good pilots race, but the general public wants its thrills en masse

[The author of the foregoing wishes, for reasons which we consider adequate, to have his name withheld He is known to us as a distinguished aeronautical publicist So far as the validity of his views is concerned, the question is referred to interested readers for their own judgment The writer of the article referred to in the October issue of AVIATION remains unconverted and of the same opinion still.—Ed.]

•

Foreign Air Race Competition

TO THE EDITOR

I want to congratulate you on your splendid article on page 202 of the October issue covering the Chicago Air Races [Afterthoughts on the races.]

You probably realize that I am heartily in accord with all you have said since only a short while ago I sent to your office a story which brought out so many of the points that you have stressed in your article

I believe that foreign participation in the Chicago Air Races has proven conclusively that we never again can hold

an exclusively national air race I believe that foreign participation will be evident in all of our future meets of this kind and I think the industry should do everything possible to encourage such participation

I found that most of the foreign pilots who participated in the Chicago Air Races were apologetic because they had not had sufficient time in which to prepare and bring over fast speed planes By the same token I am sure that next year if an invitation is extended to the European countries to participate that they will send over here some of their best speed jobs accompanied by their pilots. I can think of nothing that will prove a greater stimulus to our own engineering fraternity than to see these foreign speed planes in the air in this country and bring to them a realization that it is quite necessary for our engineers to pay more attention to speed development

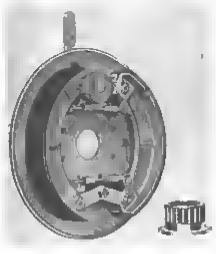
I sincerely hope that the entire industry will read your article as I believe it contains more real food for thought than anything I have read for a long time

FRED L. FOSTER
Manager, Dept of Aviation
Richfield Oil Corp of N Y

The Buyers' Log Book

Airplane Brake

ONE of the recent developments of Aircraft Products Corp. of Detroit is an airplane brake with interchangeable parts The energizing mechanism consists of a double acting cam, and every part of each shoe has



Airplane Products Corp. brake

contact with the drum The lever may be actuated in either direction The brake is internally expanding and its efficiency is equal in either a forward or backward motion of the plane Adequate braking surface is obtained by the use of a large hub

The parts in each wheel are interchangeable, and any part of the brake will fit in either wheel Roller bearings are used. The wheels are made in the following sizes 650 10 which also accommodates a 750 10 tire, 850 10, and 950-12, which accommodates a 1,100-12 tire.—AVIATION, *November 1930*

Goodyear Repair Gun

A TREAD cut repair gun resembling a familiar type of grease gun and using a special tread cut repair gum has recently been introduced by the Goodyear Tire & Rubber Company, Akron Ohio The pointed nozzle of the gun is inserted into the cut and the gum forced in by pressure of a screw plunger The tire can be used immediately and the repairing of a cut will prevent later tire failure resulting from dirt and moisture working beneath the tread or between plys—AVIATION, *November 1930*

Kalif Bearing Metal

PLAIN bearings and bearing metal for aviation and other uses have recently been placed on the market by the Kalif Corp of Emeryville, Calif The bearing metal is a uniform alloy of pure copper and lead made by a new method upon which patents are pending. Physical properties of this material include the following ultimate tensile strength at 21 deg. C. 10,000 lb per sq in., at 105 deg. C. 7,100 lb per sq in, and at 213 deg. C. 5,360 lb, per sq. in.; Brinell hardness at 21 deg. C. 28; coefficient of expansion per deg. F. 0 00001 12, weight per cu in. 0 342 lb; and melting point 952 deg. C.

Bearings are made and supplied in four different types solid centrifugally cast, bronze reinforced journal bearings, steel backed integrally welded, and bonded steel, cast iron or bronze backed. —AVIATION, *November, 1930*

Newhart Airwheel Brake

AN airwheel brake of extreme simplicity has just been introduced by the Newhart Brake Co, San Francisco Calif Brake and hub are built and sold as a unit ready for installation on any standard axle There are only five parts in the entire mechanism, including the hub. The brake is not self energizing, is of positive action and will not seize or lock, according to the manufacturer

Braking action is obtained by means of two disks of conical shape located at the inner and outer ends of the hub. Because braking friction is at the ends of the hub and away from the tire, no heat is transmitted to the inner tube The brake is recommended for amphibion use, since water is automatically thrown away from the braking surfaces as soon as the wheels start their rotation—AVIATION, *November, 1930*

Hangar Construction

DEVELOPMENT of a new method for constructing the arch type concrete airplane hangar was recently announced by Arthur J Barzaghi, of New York City In construction by this method a temporary traveling truss supports precast concrete blocks of special design in such a manner that reinforced concrete ribs can be cast between the parallel rows of blocks. The blocks support the structure when the traveling center is struck until such time as the ribs have set, thus allowing the process to continue without delay.

The general curve of the arch is that of an inverted catenary, and the function of the ribs is to furnish resistance to take care of bending stresses caused by eccentric live loads General illumination of a diffused character is furnished by installing small glass prisms in the tops of the cellular blocks It is claimed that this method of construction will reduce the cost of the arch type concrete hangar to a point which will permit its use where fireproof construction is desired—AVIATION, *November, 1930*

New Catalogs

▶ *Stearman Planes* Information on current production models put out by the Stearman Co is contained in a recent booklet which also lists aerodynamic and performance data

▶ *Stanley Aircraft Hardware* A new Stanley Catalog No 1 shows the line of products handled by the aircraft division of the company Among the products described are locks, hinges, latches and handles to meet aviation requirements

▶ *Mechanic's Handbook* Hand Bonk No 33, just announced by the South Bend Lathe Works, is a 32-page, two-color booklet which explains the use of a back-geared screw cutting precision lathe on servicing jobs in repair and service shops

▶ *Campbell Nibbling Machines* Andrew C. Campbell, Inc., has issued a new catalog describing the line of Campbell nibbling machines This explains in detail the operation of the machine in the cutting of sheet metal

Abstracts and Reviews

BIPLANE WING FLUTTER

THE WING FLUTTER OF BIPLANES, *By W. J Duncan, British Aeronautical Research Committee R. & M. No 1227*

THE theory of wing flutter of monoplanes developed in R. and M. No 1155 has been extended to cover biplanes The general method of treatment was the same in each case

The first case was that of an unstaggered biplane having equal upper and lower planes, and at first it was assumed that the bracing was so stiff that the nodes were at the outermost interplane struts, that is, the struts remained stationary during flutter Also it was supposed that the upper and lower wings were aerodynamically independent, and the only coupling of their oscillations was the mechanical one provided by the interaileron strut. Since the oscillatory motion of this strut was parallel to itself it was assumed to be replaced by an ideal massless strut and by a pair of massive particles, each of half its mass, acting at its ends these particles being treated as appertaining to the ailerons

The earlier experiments with monoplanes indicated that though, strictly speaking, a single wing-aileron system has an infinity of degrees of motion, the system can usually be treated as ternary Since one degree is lost by the interconnection of the ailerons, the system composed of the upper and lower wings with their ailerons was considered as having five degrees of freedom. Analysis of the system was still impossible, but it was demonstrated by a physical argument that when the upper and lower wings are in all respects identical, the quinary motion can be resolved into a ternary motion of a single wing aileron system and a binary motion in which the interaileron strut is stationary

The equations of motion of the system were derived and the general conditions for stability studied A considerable number of the couplings could be eliminated by placing the c.g. of each aileron on or slightly ahead of the hinge axis making the flexural axis of the wing to coincide with the axis of independence and mass balancing the wing about that axis It was concluded from a study of the binary motion that the best position for the interplane struts is slightly outboard of the midspan of the aileron and that the interaileron strut and aileron control should lie as nearly as possible in the same plane as the interplane struts.

The second case considered was that of an equal unstaggered biplane without restriction as to the position of the nodes for experiments indicated that the vibratory motion of the outermost interplane struts in flutter is not always negligibly small, and their oscillations must be considered in the theory

It was assumed that the outermost incidence truss could be treated as rigid, and that bodily yawing oscillations of the wings in phase did not occur. Then the motion of the system could be described in terms of eight co-ordinates Φ, flexural or normal displacement of the outermost incidence truss, Θ, torsional displacement of the same about an axis passing through its center, ϕ_1, ϕ_2, "flexural" displacements of the upper and lower overhangs, respectively, measured relative to the positions which they assume in a pure Φ displacement, θ_1, θ_2, torsional displacements of the upper and lower wings, respectively, measured relative to the truss, at a certain chosen section, ξ_1, ξ_2, aileron angles for the upper and lower wings, respectively Since the ailerons were interconnected, there were seven degrees of freedom. It was shown that the general motion could be resolved into a binary motion in which the wings move equally but in opposition, and a quinary motion in which they move in phase. The binary motion was the same as for the first case and the equations of motion, together with the conclusions drawn therefrom held good It was found by experiment that when the biplane is unstaggered the Θ motion is extremely small, consequently, it was neglected and the quinary motion considered as only quaternary

No attempt was made to discuss the stability of motion in general, but it was assumed that all the methods of flutter prevention recommended in R and M No 1155 had been applied to the wings separately Then the quaternary motion resolved into a torsional-aileron motion of the ordinary type and a binary motion involving merely flexure. Both motions were stable under the given conditions, so it was concluded that the quaternary flutter could be eliminated by means of the usual measures for preventing flutter Of these, the most important by far was the mass balancing of the aileron about its hinge axis

The third case to be considered was that of an unstaggered biplane with unequal wings The equation of motion could be deduced as before, but in general the motion could not be resolved into smaller components Equations were so complicated as to make useful conclusions impossible. Definite deductions were made for two special cases:

(1) If the upper overhang is long as compared with the lower, mass balance of the ailerons about their hinges may not effectively suppress flutter unless the interaileron strut lies close to the interplane struts Provided that the latter condition is realized, flutter can be avoided by the same measures as for a biplane with equal overhangs

(2) If both overhangs are short, the only important vibratory motions will normally be a general flexural (Φ) motion and an aileron (ξ) motion, and mass balance of the ailerons will be sufficient normally to eliminate flutter

The effect of stagger on wing flutter was investigated and found to be negligible, provided that the wing structure is sufficiently stiff to limit the torsional motion to a small amount.

The placing of concentrated loads such as fuel tanks, in a wing within a bay was also found to have only a slight effect upon the critical flutter speeds. In fact, such loads may increase the critical speed slightly due to the resulting increase of the effective stiffness of the spars.

Part I of this report was devoted to the theoretical work discussed above Part II describes some wind tunnel experiments undertaken in order to check the theory and the recommended preventative measures The model used consisted of a pair of planes of thin section, each provided with an aileron, interconnected by struts, and attached at the roots to a wooden block which was screwed to the floor of the wind tunnel The planes could be adjusted for stagger and overhang and the positions of the interplane and interaileron struts could be varied along the span The ailerons were provided with detachible insets in the leading edge balance about their hinges

The conclusions gained from the experimental work agreed closely with the theory developed in Part I

It is of interest that no purely flexural torsional flutter (i.e., flutter in which the ailerons played no essential part) was observed in the experiments, even with the longest overhangs and weakest bracing With the ailerons not mass balanced, a critical flutter speed as low as 11 feet per second was found in some tests, but no flexural-torsional flutter was obtained within the range of wind speed available Thus it is evident that one of the first essentials in preventing wing flutter is to eliminate the participation of the ailerons in the flutter, either by means of an irreversible control or by mass balancing the ailerons about their hinge axes. This is in accordance with conclusions previously reached originally in the Netherlands and more or less independently in several countries, for monoplanes

EFFECT OF SUPERCHARGERS

THE EFFECT OF SUPERCHARGER CAPACITY ON ENGINE AND AIRPLANE PERFORMANCE *By O W Schey and W D Gove, N A C A Tech Report No 327*

THE object of this investigation was to determine experimentally the effect of the capacity of a Roots type

supercharger on the performance of an airplane and its engine

The machine tested was a DH4-N2 airplane powered with a Liberty 12 engine The latter was fitted with a Roots type supercharger, N A C.A. model 11 of 0 382 cubic feet of displacement per revolution The supercharger capacity was varied by driving the supercharger at various ratios of the engine speed. The propeller used on all flights had previously been calibrated on the same airplane by means of a hub dynamometer, to give a curve of its variations in torque coefficient with V/nD

The four supercharger capacities, obtained by driving the supercharger at 1 615, 1 957, 2 4, and 3 times engine speed, enabled the maintenance of sea-level pressure at the carburetor to altitudes of 7,000, 11,500, 17,000, and 22,000 feet respectively.

The rate of climb and speed in level flight were taken as the basis of comparison for performance. To determine the best rate of climb without supercharging and for each of the four supercharging conditions a continuous climb was first made at the air speeds estimated to give the best rate of climb, a second climb was made at airspeeds 5 m p h. higher than in the first flight and a third climb at air speeds 5 m.p h lower than in the first flight. From these three climbs, the airspeeds for the best rate of climb were determined, and a final continuous climb was made at the selected air speeds On all supercharged climbs the pilot first attained full throttle conditions, and then, by regulation of the supercharger by pass valve, maintained as nearly as possible a pressure of 29.92 inches of mercury at the carburetor inlet. These pressures, which were indicated by a sealed altimeter in the cockpit, were maintained constant until the by pass valve was completely closed The desired air speed was obtained by varying the attitude of the airplane

To obtain high-speed performance, level runs of approximately six minutes duration were made at increments of 5,000 feet altitude for each condition

During all of these tests the following readings were taken atmospheric pressure, atmospheric temperature, supercharger inlet and outlet air temperatures, carburetor inlet air temperature and pressure drop from the carburetor inlet to the inlet manifolds, volume rate of fuel flow, fuel temperature at the flow meter, air speed, engine speed, and time

The performance curves indicated that a further increase in supercharger capacity over that obtained with the 3 1 drive would not only give but little increase in ceiling and high altitude performance, but would also seriously impair the performance near the critical altitude

The loss in performance at sea-level with the larger capacities was found to be surprisingly small

The height to which sea-level high speed was maintained or bettered became a larger percentage of the maximum height of operation of the plane as the supercharger drive ratio was increased.

Side Slips

BY ROBERT R. OSBORN

HAVING just returned, all worn out, from our vacation, we find ourself with insufficient resistence to the temptation to turn the microphone over to C F McR, the demon defender of Pacific Coast aviation Pacific Coast aviation isn't worth this much space, you understand, it's just that we are in such a weakened condition from our vacation, and have come back to the office to rest and recover, that we allow him to break in this way·

"Dear Sir I've been too pressed for time since the Chicago affair to even attempt to call attention to the many wonderful things which have been happening lately in California aviation, not the least of which is the new type of endurance record being attempted out here. They are trying to see how many times a plane attempting an endurance record can come down for how many different reasons, and still stagger off the ground again for another crack at the so-called record. The ship is up for the fourth time now Each time it has come down for a different reason and each time has gone back up with a different crew

"We have also been not a little taken back by the widespread enthusiasm which has attended the recent little hops which your glider pilots have been making off of hay stacks farmers' barns and more recently I understand, some of the bolder ones have catapulated themselves from the low hills near Elmira. Even there they picked a spot directly over a river so they would have a soft spot to land in Well we have a young married fellow out here who didn't have enough money for divorce and alimony, so he took his glider to the top of Mt. Wilson and soared off from an altitude of 6000 feet by Greenwich observatory U S Standard time It was of no use however, as his wife was waiting for him at the bottom, and he has temporarily abandoned gliding until he can secretly build a plane which will permit him to soar farther from his domestic difficulties

"We did have some good luck with the development of the balloon beacon for guiding pilots to fogged-in airports It works excellently but we have not yet found a way to eliminate the cable around which we fear the Eastern pilots would spiral down to the airport, thus cheating the real purpose of the balloon, which is to make the pilots guess its approximate location over the field and then shoot for the landing area to see who can hit it We are working on the elimination of the cable now and expect to put this whole project on a fair and square basis soon, so as to give no one group of pilots any chance to exercise unfair advantages over their less sophisticated brothers Of course, regardless of equipment, we have always had superior pilots in California At the present time all of the men and women and most of the school children in California hold pilot's licenses, or at least wear pilot's wings"

C. F. McR. sends in a clipping from a contemporary magazine stating that 'The two new Dornier 'DO-X' are to be completed in May, 1831"

This is an old trick of the manufacturers, you know—setting the date ahead a bit so that the boys in the shop will hustle up and get the ship out

The news from our foreign correspondents seems to be of a widely diversified nature this month. The following report is not so surprising, however, when one considers that it comes from Miss H L, our Mexican correspondent, who sent in the other accounts telling about pilots down there who bend longerons with their heads and never experience any head winds "Did I ever tell you about the Mexican variety of cockroach? Well it is only slightly smaller than a Monocoupe, and when it revs up it can be heard across the room. Don't let anyone tell you they can't fly It isn't just a take-off and glide down to the floor, but they climb right into the air and zizz along until the old armor rattles They seem to fly straight ahead only never dodging so it is best for one to keep out of their way"

As this seems to cover Mexican aviation activities for the past month, we take it that things down there must be in a bad way

From Norway comes the news that an airplane, flying 105 miles an hour, was beaten in a cross country race by five carrier pigeons and tied by a sixth one The distance was seventy miles and the ship started at the same time the pigeons were released Possibly one great incentive for the pigeons to hurry up was the knowledge that there was a good pigeon dinner waiting for them at the home roost. This suggests the thought that if some airplane designer is able to develop an airplane which will be hungry most of the time, we might see something really fast

MANUFACTURERS' SPECIFICATIONS ON ENGINES AVAILABLE FOR COMMERCIAL USE

AVIATION does not assume responsibility for the figures given

Manufacturer or Agent	Engine	Cooling System	Cylinder Arrangement	No. of Cylinders	Strokes per Cycle	Propeller Drive	Rated Hp. and R.P.M.	Maximum Hp. and R.P.M.	Weight Dry without Hub and Starter	Weight for Rated Hp.	Bore and Stroke (in.)	Compression Ratio	Displacement (Cu.in.)	Frontal Area (Sq.ft.)	Diameter of Mounting Ring or Distance between Bearers (in.)	Height or Diameter (in.)	Length without Starter (in.)	Guaranteed Fuel Consumption Lb. Hp. Hr.	Oil Consumption Lb. Hp. Hr.	Valve Mechanism	Cylinder Construction (See Key)	No. Intake Valves Per Cylinder	Make Spark Plugs Supplied with Engine	No. Exhaust Valves Per Cylinder	Type of Ignition	Make Ignition	No. Carburetors	Make Carburetors	Make Starter	Are Exhaust Manifolds Provided	Shipping Weight Crated	Dept. of Commerce License	Cost at Factory
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Key: [illegible]

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	Designation	A.T.C. No.	Price at Factory	Type	No. of Seats	Span	Length Overall	Height Overall	Make Engine	Total Rated Hp.	H.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed Gal. per Hr.	Make of Prop.
Aeromarine Klemm Corp	AKL-25-A	121	3,350	OML	2	40' 2"	24' 6"		Salmson	40	1,900	15			Aero
Aeromarine Klemm Corp	AKL-26-A	204	3,550	OML	2	40' 2"	25' 6"		LB	65	1,950	20			Aero
Aeromarine Klemm Corp	AKL-26-B	334	3,700	OML	2	40' 2"	25' 1"		Lb	85	2,125	20			Aero
Alexander Aircraft Co.	Eaglerock A-2	58	2,000	OBL	2	36' 0"	24' 11"	9' 11"	OX 5	90	1,400	30	460	7	W, Su
Alexander Aircraft Co.	Eaglerock A 12	139	5 242	OBL	2	36' 0"	24' 2"	9' 10"	Co	150	1,800	50	623	8	Hs
Alexander Aircraft Co.	Eaglerock A-15	140	5 902	OBL	2	36' 0"	25' 11"	9' 10"	K	90	1 720	30	550	6	W, Su
Alexander Aircraft Co.	A-13	141	5 959	OBL	2	36' 0"	25' 0"	9' 10"	Wr Cn Ch	123	1,800	50	555	8	Hs
Alexander Aircraft Co.	C-2 Bullet	318	2 200	OML	4	36' 0"	26' 10"	9' 2"	Ww	165	2,000	41	560	9	Hs
Alexander Aircraft Co.	A-1	57	*2,250	OBL	3	36' 0"	25' 11"	9' 10"	Ww	225	1 700	50	590	11	Hs
American Aeronautical Corp	M-56	262	2 525	OBA	3	36' 1"	25' 2"	10' 1"	K	100	1,800	25	250	2	F
American Aeronautical Corp	S-56B	336	7 025	OBA	3	34' 1"	25' 2"	10' 1"		100	1,800	25	320	2	S F
American Eagle Aircraft Co	330	119	4 795	CML	5	37' 0"	24' 0"	8' 4"	K	100	1,850	50	460	8	S Hs
American Eagle Aircraft Co	251	262	5 995	OBL	3	51' 1"	23' 3"	8' 4"	Ww	165	1,950	60	550	9	Hs
American Eagle Aircraft Co	D-450	501	6,395	CLM	4	41' 1"	24' 2"	8' 1"	Wr Ww	165	1,850	60	580	9	Hs
American Eagle Aircraft Co	C-450	320	5 995	CML	4	41' 1"	24' 2"	8' 1"	Cm	165	1,850	60	580	9	Hs
American Eagle Aircraft Co	251	295	3 995	OBL	3	51' 1"	22' 11"	8' 5"	K	100	1,850	36	425	6	S H
Arrow Aircraft & Motors Corp	A2/60I	113	1 511	OBL	2	25'10"	19' 5"	7' 5"	Ha	60	1,950	16	200	4	He
Auch Aircraft Co	3-CT-B	172	39 500	CML	10	58' 5"	34' 10"	10' 1"	Pwh 2 Ww	855	1,800	200	525	42	Hs
Auch Aircraft Co	3-CT-P	271	39,500	CML	10	58' 5"	34' 10"	9' 0"	Pww 2 Ww	925	1,900	200	525	42	Hs
Bellanca Aircraft Corp	Pacemaker	126	16,950	OML	6	46' 0"	27' 10"	8' 4"	Wr Ww	300	2,000	112	700	16	S H
Bellanca Aircraft Corp	CH 300 Seaplane	129	18 000	CMP	6	46' 0"			Wr Ww	300	2,000	112	700	16	S H
Bellanca Aircraft Corp	Troubles	242	15 000	CML	4	46' 0"	27' 10"	8' 4"	Wr Ww	300	2,000	85	670	16	S Hs
Bellanca Aircraft Corp	Pacemaker	320	15 450	CML	6	46' 0"	27' 10"	8' 4"	Pw	300	2,000	112	930	16	S Hs
Bellanca Aircraft Corp	Skyrocket	319	17 000	CML	6	46' 0"	29' 5"	8' 4"	Pww	420	2,000	115	650	22	Hs
Brunner-Winkle Aircraft Corp	Bird Model A	101		OBL	2	34' 0"	22' 0"	8' 0"	OX 5	90	1,400	45	800	7	W, Su
Brunner-Winkle Aircraft Corp	Bird, Model B	239		OBL	2	34' 0"		8' 0"	K	110	1,825	45	800	7	W, Su
Buhl Aircraft Co.	CA-6-A	98	10 500	COL	2	40' 0"	26' 6"	10' 0"	Cy	525	1,900	101	775	20	HSt
Buhl Aircraft Co.	CA-6-B	99	10 500	COL	2	40' 0"	26' 6"	10' 0"	Pwh	525	1,900	101	775	20	HSt
Buhl Aircraft Co.	CA 6	126	13,500	COL	2	40' 0"	29' 0"	8' 7"	Wr Ww	300	2,000	100	720	16	HSt
Buhl Aircraft Co.	CA 3-D	165	12,000	COL	2	36' 0"	28' 0"	9' 0"	Wr Ww	300	2,000	90	700	16	HSt
Cessna Aircraft Co	DC-6-A	243	11 500	CML	4	40' 0"	22' 11"	7' 0"	Wr Ww	300	2,006	66		13	0 Su, H
Cessna Aircraft Co	DC-6-B	244	9 750	CML	4	40' 0"	22' 11"	7' 0"	Wr Ww	225	2,000	66		11	0 Su H
Command Aire Inc.	3 C-3A	118	4 675	OBL	3	32' 6"	24' 5"	8' 4"	War	110	1,850	44	500	7	0 H, Su
Command-Aire Inc.	5 C-3 Ch	184	5 600	OBL	3	34' 1"	25' 4"	8' 4"	Cn Ch	120	1,800	55	600	9	0 HSt
Command-Aire Inc.	5 C-3 Ax	214	5 600	OBL	3	34' 1"	25' 4"	8' 4"	Ax	150	1,800	55	750	7	5 Su, H
Command-Aire, Inc.	5-C-3-C	253		OBL	3	34' 1"	25' 4"	8' 4"	Wr Ww	165	2,000	55	750	7	5 Su, H
Command-Aire, Inc.	3-C-3-A	151	4 675	OBL	3	34' 1"	24' 5"	8' 4"	War	110	1,850	48	800	5	5 W, Su
Consolidated Aircraft Co	Commodore	259		CMF	25	100' 0"	61' 6"	15' 6"	2 Pwh	1,650	1,950	650	1 660	65	StS
Consolidated Aircraft Co	Model 17 Type 1	291		CML	8	65' 5"	51' 9"	9' 2"	Pwh	575	1,950	150	500	32	HSt
Consolidated Aircraft Co	Model 20 Type 2	520		CM	6	45' 5"	36' 9"	10' 7"	Pwh	573	1,950	150	500	32	S H
Conner Monoplane Co	PB-1	265	5 750	CML	5	37' 0"	22' 0"		K	90	1,623				
Crown Motor Carriage Co	Custombilt B-3	199	4 925	OBL	2	28' 0"	21' 6"	8' 6"	K	90	1,825	25	400	6	0 Su, H
Cunningham-Hall Aircraft Corp	PT 6	177	13,900	OBL	2	41' 0"	29' 0"	9' 11"	Ww Wr	300	2,000	90	700	15	0 HSt
Curtiss Aeroplane & Motor Co	Carrier Pigeon	257		OBL	1	47' 6"	34' 6"		Cn Cp	600	2,400				Cu Re
Curtiss Aeroplane & Motor Co	Fledgling Cn	191		OBL	3	36' 3"			Cn Ck	120	1,800	40			
Curtiss Aeroplane & Motor Co	Fledgling K2	269		OBL	3	36' 5"			Lb	90	1,825	40			
Curtiss Aeroplane & Motor Co	Condor	195		CBL	21	91' 8"	57' 1"	16' 6"	2 Cn Cu	1,200	2,400	227			Cn Re
Curtiss-Robertson Airpl Mfg Co	Robin OX 3	60	2,495	OML	3	34' 1"	23' 0"	8' 10"	OX 5	90	1,400	50	401	7	0 Hs
Curtiss-Robertson Airpl Mfg Co	Robin C-1	143	5 995	CML	3	41' 1"	25' 10"	8' 0"	Cu Ch	165	1,800	50	300	14	0 Cu Re
Curtiss-Robertson Airpl Mfg Co	Robin J-1	220	5 995	CML	3	41' 1"	25' 6"	8' 0"	Wr Ww	165	2,000	50	330	12	5 HSt
Keystone-Loening Aircraft Corp	Air Yacht	99		CBA	10	86' 0"	64' 9"	23' 2"	Wr Cy Pwh	525	1,800	140	1 220	28	0 HSt
Keystone-Loening Aircraft Corp	Commuter	219	16,800	CBA	4	46' 0"	32' 1"	13' 6"	Wr Ww	300	2,000	70	400	15	0 HSt
Keystone-Loening Aircraft Corp	Patrician	260		CML	20	90' 0"	61' 2"	13' 4"	3 Cy 3 Pwh	1 575	1,800	535	720	99	0 HSt
Meth Aircraft Corp	Gipsy Meth 60GM	197	5 900	OBL	2	30' 0"	25' 11"	8' 9"	Wr Cy	85	1,900	55	540	7	0 Gar
Travel Air Mfg Co	A 6000-A	116	16 500	CML	6	54' 5"	31' 2"	9' 2"	Pww	420	2,000	150	700	20	0 HSt
Travel Air Mfg. Co	6000-B	150	13 500	CML	6	48' 6"	31' 2"	9' 3"	Wr Ww	300	2,000	80	550	10	0 HSt
Travel Air Mfg. Co	6-4000	188	9,250	OBL	6	33' 3"	24' 7"	9' 1"	Wr Ww	165	1,800	67	575	10	0 HSt
Travel Air Mfg Co	4-D	254	7 960	OBT	4	33' 3"	23' 4"	9' 1"	Wr Ww	225	2,000	67	580	14	0 HSt
Davis Aircraft Corp	Del	258	2 895	OML	2	30' 0"	19' 10"	8' 2"	Lb	65	1,950	20	350	4	5 Ha
Davis Aircraft Corp	D1 K	327	3,595	OML	2	30' 0"	19' 10"	8' 2"	Lb	100	1,850	25	350	4	5 Ha
Davis Aircraft Corp	D1-B5	317	5 595	OML	2	30' 5"	21' 6"	7' 7"	Lb-85	85	2,125	20	350	5	0 Ha
Detroit Aircraft Corp	E-2 Sea Rover	288	9 985	ORF	4	56' 1"	36' 3"	8' 9"	Cr Ch	170	1,600	48	560	10	6 HSt
Eastman Aircraft Corp	E-2-A	338	10 000	CBA	4	56' 1"	36' 5"	9' 2"	Cn Ch	165	1,900	48	560	10	0 HSt
Eastman Aircraft Corp	E-3-A	102	15 985	CML	5	42' 6"	27' 6"	9' 5"	Pww	425	1,800	100	700	20	0 HSt
Lockheed Aircraft Co	Vega Model 5B	222	18 993	CMI	7	41' 7"	27' 6"	8' 4"	Pww	423	1,800	100	650	20	0 HSt
Lockheed Aircraft Co	Sirius	506	18 995	OML	2	42' 10"	27' 10"	9' 8"	Pww	450	2,100	75	1 000	20	HSt5
Page Air Collegeo, Inc	P 1	179	1 700	OBL	2	30' 1"	24' 4"	9' 4"	OX 5	50	1,400	32	350	6	5 Ha
Ryan Aircraft Corp	B-5	142	12,500	CMI	4	42' 4"	28' 3"	8' 10"	Wr Ww	300	2,000	100	700	15	0 HSt
Ryan Aircraft Corp	B-2	262	16,500	CMI	4	42' 4"	29' 11"	8' 10"	Pww	425	1,900	100	800	20	0 Hs
Doyle Acro Corp	AO-2	242	2 595	OML	2	30' 0"	19' 0"		Lb	60	1,950	23	425	3	0 He
Driggs Aircraft Corp	Skylark	303	2,995	OLS	2	28' 3"	21' 6"	8' 0"	Rover	75	1,773	17	300	5	0 Hs
Fairchild Aviation Corp	42	242	12 900	CML	4	45' 6"	30' 6"	9' 3"	Wr Ww	300	2,000	100	650		HSt
Fairchild Aviation Corp	71-A	289	10 900	CML	2	50' 2"	32' 11"	9' 3"	Wr Ww	420	1,800	140	650		HSt
Fairchild Aviation Corp	KR 54A	162	6 375	OBL	3	50' 2"	25' 9"	9' 3"	Wr Ww	165	2,000	50		10	0 HSt
Fairchild Aviation Corp	KR-21	213	4 375	OBL	2	27' 2"	22' 1"	9' 3"	h	90	1 810	25		6	0 He Su
Fleet Aircraft Inc.	Model 1	122		OBL	2	28' 0"	20' 9"	7' 10"	War	610	1,850	24	350	6	0 Ha
Fleet Aircraft Inc.	Model 11	151		OBL	2	28' 0"	20' 9"	7' 10"	K	110	1,950	24	552	6	0 Ha
Fokker Aircraft Corp	AF 10A	96	54 500	CML	14	79' 3"	50' 7"	13' 9"	5 Pww	1 200	2,000	300	755	60	0 HSt
Fokker Aircraft Corp	X Universal	164	11 000	CMI	7	47' 9"	35' 6"	9' 6"	Wr Ww	300	2,000	79	535	15	5 St
Fokker Aircraft Corp	AF 11A	222	33 773	CMA	7	59' 5"	45' 10"	14' 5"	Pwh, Cy	525	1,900	120	450	28	0 St
Fokker Aircraft Corp	AF-14	234	22,500	CMI	9	59' 3"	45' 4"	12' 4"	Pwh, Cy	525	1,900	120	730	27	0 HSt
Fokker Aircraft Corp	AF-52	281	110 000	CMI	32	90' 0"	70' 2"	16' 2"	4 Pwh	2,500	1,950	700	770	112	HSt
Fokker Aircraft Corp	Super Universal	52	17,900	CML	8	50' 0"	36' 11"	9' 1"	Pww	920	2,000	120	675	24	HSt
Ford Motor Co	4-AT-E	132	40 000	CML	14	74' 4"	49' 10"	11' 9"	3 Wr Ww	900	2,000	231	520	45	Hst

See page 314 for key

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	Designation	A.T.C. No.	Price at Factory	Type	No. of Seats	Span	Length Overall	Height Overall	Make Engine	Total Rated Hp.	H.p.m. at Rated Hp.	Fuel Cap. (Gal.)	Normal Range	Fuel Consumption at Cruising Speed Gal. per Hr.	Make of Prop.
Ford Motor Co	5-AT-C	165	50 000	CML	11	77' 10"	49' 10"	12' 0"	3 Pww	1 260	2,000	272	510	60	HSt
Ford Motor Co	2 AT	246	42,000	CML	11	77' 10"	49' 10"	12' 0"	2Wr Ww, Pww	1,140	2,000	201	615	50	Hst
Ford Motor Co	5-AT-C-S	296	60 000	CMZ	13	77' 10"	51' 4"	14' 6"	3 Pww	1,260	2,000	272	490	60	Hst
General Airplane Corp	Aristocrat	112	4,250	CML		36' 4"	25' 4"	7' 0"	War	110	1,850	4	600	5	0 Hst
General Airplane Corp	Aristocrat 102-E	210	5,250	CML	3				Ww	165					
General Airplanes Corp	Cadet 111-C	229	4 000	OML	2				War	110					
Great Lakes Aircraft Corp	TT-1A	228	3 190	OBL	2	34' 0"	20' 4"	7' 11"	Cir	90	2,100		320	6	5 Ha, H
Inland Aviation Co	S-300	259	3,495	OML	2	30' 0"	19' 11"	7' 3"	Lb	60	1,950	24	450	4	0 Ha
Inland Aviation Co	W 500	315	4,995	OLM	3	50' 0"	25' 1"	7' 4"	War 2	110	1,975	31	500	7	Hst
Ireland Aircraft, Inc	N 2 B	153	18,000	CBA	4	46' 0"	31' 1"	12' 2"	Wr Ww	300	2,000	80	450	15	0 Hst
Ireland Aircraft, Inc	N-2-C	240	23 000	CBA	4	46' 0"	31' 1"	12' 2"	Pww	420	2,000	80	450	18	0 Hst
E M Laird Airplane Co.	LC-R-300	126	11 500	OBL	2	34' 0"	23' 9"	9' 3"	Wr Ww	300	2,000	26	550		Hst
E M Laird Airplane Co	LC-RJ 200	152	9 500	OBL	2	30' 0"	20' 2"	9' 3"	Wr Ww	220		26	600		Hst
Lincoln Aircraft, Inc	FT	181	2 565	OBL	2	32' 3"	23' 2"	8' 10"	OX 5	90	1,400	29	300	8	0 Ha, Su
Lincoln Aircraft Inc	FT K	279	3 065	OBL	2	32' 3"	23' 7"	9' 3"	K	90	1,825	20	400		Su
Lincoln Aircraft Inc	FT W	284	4 315	OBL	2	32' 3"	23' 3"	9' 3"	War	110	1,850	20	400		Su
Mercury Aircraft Inc	Chic	251	3,000	OML	2	30' 0"	23' 7"	8' 2"	Lb	90	2,000	22	525	7	He
Metal Aircraft Corp	G 2-W	192	21,000	CML	8	50' 0"	32' 6"	9' 6"	Pww	425	1,800	140	700	22	Hst
Mohawk Aircraft Corp	M 1-CK Pinto	263	4,000	OML	2	34' 11"	24' 2"	7' 2"	K	90	1,825	32	430	7	He
Mohawk Aircraft Corp	M 1-CW Pinto	292	5,100	OML	2	34' 11"	24' 2"	7' 2"	War	110	1,950	32	450	7	5 He
Mono Aircraft Corp	Monosprep	218	2,495	OML	2	32' 2"	21' 0"		Lam	55	2,000				
Mono Aircraft Corp	Monocoupe 110	327	4,500	CML	4	32' 0"	20' 4"	6' 11"	War 7	110	1,950	30	450	6	0 He
Mono Aircraft Corp	Monocoach	275	8,250	CML	4	50' 0"	26' 9"		Wr Ww	225	2,000				
New Standard Aircraft Corp	D-25-A	214	3,151	OBL	2	50' 0"	24' 5"	9' 0"	K	100	1,900	22	282	7	He
New Standard Aircraft Corp	D-25-A	224	2,900	OBL	2	5 45	26' 6"	10' 2"	Wr Ww	225	2,000	62	500	12	4 Hst, Su
Nicholas-Beazley Airplane Co, Inc	Bathing NB-3	174	3,600	OML	2	32' 0"	22' 11"	7' 3"	K	65	1,950	16	350	4	7 W
Nicholas-Beazley Airplane Co, Inc	Bathing NB-3V	230	3,600	OML	2	32' 0"	22' 3"	7' 3"	Lam	70	2,200	16	380	4	7 W
Nicholas-Beazley Airplane Co, Inc	Bathing NB-3G	231	3,600	OML	2	32' 0"	22' 5"	7' 5"	Ge	80	2,200	16	400	6	W
Ogden Aeronautical Corp	Osprey	532	12 900	CLM	4	50' 0"	34' 6"	9' 5"	(3) Cw	270	2,000	90	500	18	0 HSt
Paramount Aircraft Corp	Commuter 165	250	5,250	OBL	3	35' 2"	24' 6"	9' 6"	Wr Ww	165	2,000	50	400	12	0 HSt
Pheasant Aircraft Co, Inc	H-10	36	2885	OBL	3	32' 6"	23' 6"	9' 0"	OX 5	90	1,400	30	400	9	0 Ha
Pitcairn Aircraft Inc	P 1-7-S	196	8,000	OBL	3	33' 0"	23' 9"	9' 6"	Wr Ww	225	1,800	21			HSt
Rearwin Airplanes, Inc.	2000-C	232	6 250	OBL	2	35' 0"	25' 0"	9' 11"	Cn Ch	170	1,800	50	500	10	0 HSt
Rearwin Airplanes, Inc	2090-CO	314	6 500	OBL	3	55' 0"	25' 0"	9' 11"	Con	165	2,000	55	500	10	0 HSt
Simplex Aircraft Corp	Red Arrow K 2-S	45	3,995	OML	2	34' 2"	23' 0"		K	90	1,823	44			W
Simplex Aircraft Corp	Red Arrow W 2-S	238	4,495	OML	2	34' 2"	23' 0"		War	110	1,850	44			W
Spartan Aircraft Co	C-3-165	195	5,075	OBL	3	32' 2"	23' 10"	8' 10"	Wr Ww	165	2,000	65	600	10	0 H
Spartan Aircraft Co	C-3-225	286	7,750	OBL	3	32' 2"	23' 3"	8' 10"	Wr Ww	225	2,000	60	495	15	0 H
Spartan Aircraft Co	C-225	316	10,250	OML	4	50' 0"	31' 6"	9' 0"	Ww	225	2,000	95	700	11	5 H
Star Aircraft Co	Cavalier C	255	2,795	CML	2	31' 6"	19' 6"	6' 4"	Lb	90	1,950	25	400		W
Star Aircraft Co	Cavalier E	321	3,450	OLM	2	31' 6"	20' 1"	6' 0"	Lam			22	900		W Su
Stinson Aircraft Corp	SM-6 E	217	15,995	CML	4	52' 0"	34' 4"	10' 0"	Pww	425	1,950	110	525	23	Hst
Stinson Aircraft Corp	SM-8 E	294	8,495	CML	4	41' 0"	29' 5"	9' 0"	Ww	225	2,000	63	575	12	5 Hst
Stinson Aircraft Corp	SM-6000	535	23 900	CLM	12	60' 0"	42' 10"	12' 0"	3-LY	645	2 000	120	31	3	5 Hst
Stinson Aircraft Corp	SM-8 A Jr	295	5,775	CML	4	41' 0"	28' 11"	8' 9"	Ly	215	2,000	60	600	11	0 Hst
Stinson Aircraft Corp	SM-7 A	298	10,495	CML	4	41' 0"	31' 0"	8' 9"	Wr Ww	300	2,000	90	430	20	0 Hst
Stinson Aircraft Corp	SM-7B	329	10,695	CML	4	41' 2"	30' 11"	8' 9"	Pwj	300	1,950	90	430	20	Hst
Stinson Aircraft Corp	SM-8D	512	9,995	CML	4	41' 0"	29' 10"	9' 0"	Diesel	225	1,950	50	580	11	Hst
St. Louis Aircraft Corp.	Cardinal C-2-110	277	3,995	OML	2	32' 0"	21' 3"	7' 3"	K	90	1,825	30	450	6	5 Ha, Su
St. Louis Aircraft Corp	Cardinal C-2 90	264	5,750	CML	2	32' 4"	21' 5"	7' 3"	Lb	90	1,950	30	425	7	0 Ha, Su
St. Louis Aircraft Corp	Cardinal C-2 65	275	5,250	CML	2	32' 4"	21' 5"	7' 3"	Lb	65	1,950	25	550	5	0 Ha Su
Swallow Airplane Co	LP	300	2,020	OBL	2	30' 11"	20' 2"	8' 10"	OX 5	90	1,400	30	500	6	0 W
Swallow Airplane Co	F 28-Ax	125		OBL	2	32' 0"	22' 7"	8' 10"	Ax	150	1,800	62	600	9	0 Su
Swallow Airplane Co	FP K	180		OBL	2	30' 11"	24' 1"	8' 10"	K	90	1,825	28	530	7	5 Su
Swallow Airplane Co	FP W	255		OBL	2	30' 11"	25' 0"	8' 10"	War	110	1,950	28	530	7	5 Su
Texas Aero Corp	Temple	45		OML	2	59' 4"	25' 10"	8' 5"	Ww Wr	200	2,000	50			
United Aircraft and Transport Corp	400	155	20 000	OBL	1	50' 0"	30' 9"	9' 7"	Pww	450	1,900	92	525	20	0 H
Boeing Airplane Co	204	152		CBF	5	39' 0"	32' 6"	12' 8"	Pww	450	1,900	80	530	20	0 Me
Boeing Airplane Co	40-B 4	105		CEL	4	44' 2"	35' 4"	11' 9"	Pwh	525	1,900	140	630	25	0 Me
Boeing Airplane Co	80 A	146		CBL	4	44' 2"	34' 8"	14' 2"	3 Pwh	1 575	1,900	400	500	90	0 Me
Boeing Airplane Co	Monomail	536		OMI	1	1 59' 0"	40' 8"	11' 6"	Pwh	573	1,950	135			HSt
Hamilton Metalplane Co	H 45	85	24 500	CML	8	54' 5"	35' 0"	9' 4"	Pww	425	1,900	140	673	23	0 Hst
Hamilton Metalplane Co	H-47	94	28,400	CML	8	54' 5"	35' 0"	9' 4"	Pwh	525	1,900	140	600	24	0 Hst
Sikorsky Aviation Corp	S-38	126	49 500	CQA	10	21 0"	50' 3"	13' 10"	2 Pww	840	1,900	350	750	64	0 HSt
Sikorsky Aviation Corp	S-39-A	340	17,500	AM	4	52' 0"	32' 1"	11' 6"	Pwj	300	2,000	66	1 725	18	0 HSt
Sikorsky Aviation Corp	S-41			AM	1	70' 9"	43' 2"	13' 5"	2 Pwh	1 150	1,950	300	1 730		HSt
Stearman Aircraft Co	NL 1	107	23 000	OBL	3	49' 5"	32' 6"	12' 6"	Pwh	525	2,000	145	720	25	0 HSt
Stearman Aircraft Co	C-3-R	251	8,500	OBL	3	35' 5"	24' 11"	9' 0"	Ww Wr	225	2,000	60	600	10	0 HSt
Stearman Aircraft Co	C-3	252	6,950	OBL	3	35' 5"	24' 11"	9' 0"	Ww	220	2,000	60	600	10	0 HSt
Stearman Aircraft Co	4-C	304	12,500	OBL	3	39' 2"	26' 11"	10' 2"	Wr Ww	300	2,000	106	730	15	0 HSt
Stearman Aircraft Co	4-D	505	12,500	OBL	3	38' 2"	28' 11"	10' 2"	Pwj	300	2,000	106	710	15	0 HSt
Vervilla Aircraft Co	Sport Trainer	325	5,250	OBL	2	31' 2"	24' 3"	8' 9"	Con	165	2,000	36	3 50	9	0 Hs
Vervilla Aircraft Co	106-S	311	11,000	OBL	4	41' 7"	30' 5"	9' 3"	Diesel	225	2,000	60	6 50	7	0 HSt
Viking Flying Boat Co	Kittyhawk B-2	134	4 450	OBL	3	28' 0"	22' 6"	8' 0"	K	113	1 710	55	500	7	0 HSt
Viking Flying Boat Co	Kittyhawk B-4	166	4,250	OBL	3	28' 0"	22' 6"	8' 0"	K	100	1810	33	500	6	3 Ha
Waco Aircraft Co	Packard	333		OBL	3	30' 7"	22' 2"	9' 0"	Diesel	223	1,980	65			HSt
Waco Aircraft Co	Continental	332	5,575	OBL	3	30' 7"	25' 1"	9' 0"	Coo	165	2,000	65	375		Ha
Waco Aircraft Co	Model F	345	4 285	OBL	3	29' 7"	21' 0"	8' 4"	5 B 5			32			Ha
Waco Aircraft Co	Jacobs	349	5,175	OBL	3	30' 7"	22' 7"	9' 0"	Jac	140	1,900				Ha
Waco Aircraft Co	10	103	6,520	OBL	3	30' 0"	23' 9"	9' 0"	Wr Ww	165	2,000	65		12	0 Ha
Waco Aircraft Co	225 str. w	240	7 555	OBL	3	30' 0"	22' 6"	9' 0"	Wr Ww	225	2,000	65	500	12	0 Ha
Waco Aircraft Co	225 tap w	525	8,325	OBL	3	30' 5"	22' 6"	9' 0"	Wr Ww	221	2,000	63	500	12	0 HSt
Waco Aircraft Co	Model F W	311	4 250	OBL	3	29' 6"	20' 9"	8' 4"	K	90	1,900	32	425	7	0 Ha
Waco Aircraft Co	Model F K	313	4 100	OBL	3	29' 6"	20' 9"	8' 4"	K	90	1,900	32	400	7	0 Ha
Warner Aircraft Corp	Arge	170	4 500	IBL	2	26' 0"	20' 9"	9' 1"	Hw	115	1,925	53	425	8	0 BSt

See page 314 for key

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	WEIGHTS: Wing Loading (Lb. per Sq. Ft.)	WEIGHTS: Power Loading (Lb. per Hp.)	WEIGHTS: Weight Empty with Water if Water Cooled Engine is Used (Lb.)	WEIGHTS: Pay Load (Lb.)	WEIGHTS: Gross Weight (Lb.)	WINGS: Spars: Material	WINGS: Spars: How Fabricated—Section	WINGS: Struts: Material	WINGS: Struts: How Fabricated	WINGS: Covering: Material	WINGS: Covering: How Attached	FUSELAGE OR HULL: Frame-work: Material	FUSELAGE OR HULL: Frame-work: How Fabricated	FUSELAGE OR HULL: Covering: Material	FUSELAGE OR HULL: Covering: How Attached	FUSELAGE OR HULL: Cockpit Dimensions	FUSELAGE OR HULL: Cabin Dimensions	FUSELAGE OR HULL: Minimum Headroom	FUSELAGE OR HULL: Vol. Baggage Comp. (Cu. Ft.)
Aeromarine, 25-A	8 5	55 1	815	239	1,525	W	Box	W	Fly	W	Fly	W		Fab						
Aeromarine, 28 A	7 57	24 5	1 025	286	1,590	W	Box	W	Fly	W	Fly	W		Fab						
Aeromarine, 28-B	7 54	18 6	1 010	205	1,561	W	Box	W	Fly	W	Fly	W		Fab						
Alexander Eaglerock A 2	7 40	37 1	1,459	340	2,442	W	Lnd-I	W	Tra	Fab	Ta	ST	WI	Fab	Ta	28x42"			4	2
Alexander Eaglerock A 12	7 85	17 2	1 885	340	2,582	W	Lnd-I	W	Tra	Fab	Ta	ST	WI	Fab	Ta	28x42"			5	9
Alexander Eaglerock A-15	7 45	24 46	1,539	340	2,456	W	Lnd-I	W	Tra	Fab	Ta	ST	WI	Fab	Ta	28x42"			4	7
Alexander Eaglerock A 13	7 89	14 49	1,711	340	2,600	W	Lnd-I	W	Tra	Fab	Ta	ST	WI	Fab	Ta	28x42"			5	9
Alexander Eaglerock, Bullet	13 5	16 9	1,720	814	2,780	W	Lnd-I	Steel	Tra	Fab	Ta	ST	WI	Fab	Ta		4'x9½"	4'	5	9
Alexander Eaglerock, A-1	7 55	12 46	1,705	34	2,491	W	Lnd-I	W	Tra	Fab	Ta	ST	WI	Fab	Ta	28x42½			5	9
American Aeronautical S-50	7 5	21 5	1 447	565	2,150	Sp	G, Box	Sp		G	Fab	Se	ST	WI	Bod	Fly	Bod	5'x4'6"		
American Aeronautical S-50 B	7 7	17 0	1 462	54	2,200	SP	G, Box	SP		G	Fab	Se	W	Sol	Bo	Fly	Sod	5'x4'x6"		
American Eagle 550			1 320	425	2,180	W	Box	W		ST	Fab	Ta	ST	WI	Fab		Ta			
American Eagle 251			1,650	522	2,669	W	Box	W		ST	Fab	Tx	ST	WI	Fab		Ta			
American Eagle 201			1 180	347	2,050	W	Box	W		ST	Fab	Tx	ST	WI	Fab		Ta			
American Eagle/D-450			1 804	55	2,992	W	Ra	W		ST	Fab	Tx	T	WI	Fab		T8			
American Eagle, C-430			1 675	550	3,368	W	Ra	W		ST	Fab	Ta	T	WI	Fab		Ta			
Arrow A2-60 L	7 35	19 5	900	170	1,240	W	G	W		G	Fab	Se	ST	WI	Fab		Se			5 0
Bach 3-CT-8	14 7	9 90	4 705	1,570	8,000	W	G Box	Fly		G	Fab	Se	W	G, Box	Fly		G	46x11"	5'	50 0
Bach 3-CT 9	14 9	0 9	5 010	1,525	8,000	W	G Box	Fly		G	Fab	Se	W	G, Box	Fly		G	46x40"	46" x11'	5'	50 0
Bellanca Pacemaker			2 565	1042	4 500	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se			57"	12 0
Bellanca CH-300 Seaplane			2,865	1,042	4 800	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se			57"	12 0
Bellanca Freighter			2,290	1,570	4 600	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se			57"	360
Bellanca Pinemaker			2,455	998	4 500	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se			57"	12 0
Bellanca Skyrocket			2,610	1,070	4 600	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se			57"	12 0
Brunner-Winkle Bird Model A	8 1	24 0	1 360	400	2 150	W		W			Fab	Se	ST	WI	Fab		Se				
Brunner Winkle Bird Model B	7 5	32 0	1 160	440	1 990	W		W			Fab	Se	ST	WI	Fab		Se				
Buhl CA 6-A	15 62	12 0	3 547	1 59	9 500	Sp	Box, S	Sp			Fab	Se	ST	WI	Fab		Se	15'4"x4'	4'7"	50 0
Buhl CA-8-B	15 62	12 0	5 542	1 59	6,500	Sp	Box, S	Sp			Fab	Se	ST	WI	Fab		Se	15'4"x4'	4'7"	50 0
Buhl CA-6	14 3	15 0	2 470	1,192	4 500	Sp	Box, S	Sp			Fab	Se	ST	WI	Fab		Se	15'4"x3'4"	4'	24 0
Buhl CA-3-D	15 5	10 86	2 017	415	3 200	Sp	Fox, S	Sp			Fab	Se	ST	WI	Fab		Se	10'4 x3'2"	4'	14 0
Cessna DC-6-A	11 07	10 61	1,952	610	3,100	Sp	Box	Fly		G	Fab	Se	ST	WI	Fab		Ta	38x40"	38"x42"	18 0
Cessna DC-6-B	11 57	15 76	2 021	610	3,100	Sp	Box	Fly		G	Fab	Se	ST	WI	Fab		Se	38x40"	38"x42"	18 0
Command-Aire 3-C-3A	7 2	19 5	2 282	592	3,447	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se	30x35		4
Command-Aire 3-C-5 Ca	7 21	14 2	1,484	540	2 500	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se	30x33"		4
Command-Aire-3-C-3 AX	7 86	15 0	1 593	355	2,572	Sp	Sol	Sp		G	Fab	Se	ST	WI	Fab		Se	30x33"		4
Command-Aire, 5-C-3-C	7 2	14 2	1 602	340	2 490	Sp	Sol	Sp			Fab	Fab	ST	WI	Fab		Se			4
Command-Aire, 3-C-3-A	7 20	19 5	1 284	210	1,990	Sp	Sol	Sp			Fab	Feb	ST	WI	Fab		Se			80
Consolidated Commodore	15 0	15 5	10 449	4 346	12 600	D	Ry	D		Ry	Fab	Se	D	Ry	D					
Consolidated, Model 12	12 9	9 75	5 526	1 508	5 000	D	Box	S		G	Fly	G	D	Ry	D			62"x280"	54"	25
Consolidated, Model 20	10 0	10 5	3 333	1 411	5 900	Fly	Box	S		G	Fly	G	D	Ry	D			62"x280"	54"	60
Courier-F-B-1	9 5	30 0	1 350		2,100	Sp	Box	Sp		G	Fab	Se	ST	WI	Fab		Se	56"	3'	
Crown Customcraft B-3	7 92	17 58	1 242		2,000	Sp	Box	Sp, Fly		Cr	Fab	Se	Fly	Wa	Fab, Fly		Ma	24x30"		
Cunningham Hall PT 0	11 7	15 5	2,670	920	4 350	Sp	Bo	D		Ry	Fab	Se	ST	WI	Fab, Cp		So, Ry	42x44"	44"x70"	60"	27-0
Curtiss-Wright Corp															Ma Mo		Ry			
Curtiss Carrier Pigeon	15		11 96	4,235		7 800	ST	WI		D					Fab		Se			
Curtiss Fledgling Ch						Sp	Lnd	Fly		G	Fab	Se	ST	WI	Fab		Se			
Curtiss Fledgling K-2						Sp	Lnd	Fly		G	Fab	Se	ST	WI	Fab		Se			
Curtiss Candor	11 5	14 47	11,552	3,600	17,570		Ry	D		Ry	Fab	Se	D	Ry	D					
Curtiss Robin DX-5	10 1	25 1	1,504	596	2,225	Sp	G	Ad		Sd	Fab	Se	ST	WI	Fab		Se	52"x92"	43"	12 3
Curtiss Robin C-1	11 7	14 05	1 650	454	2,600	Sp	G	Ad		Sd	Fab	Se	ST	WI	Fab		Se	32"x92"	43"	12 5
Curtiss Robin J-1	11 3	15 3	1,625	370	2,525	Sp	G	Ad		Sd	Fab	Se	ST	WI	Fab		Se	52"x92"	43"	12 5
Keystone Air Yacht	12 1	11 90	5 895	1,150	6,300	Sp	Sol	D		Sd	Fab	Se	W	D	Sod			5'5"x4'	4'	20
Keystone Commuter	9 50	15 8	2,850	640	4,150	Sp	Sol	D		Sd	Fab	Se	D	Ry	Fab		Se	5'5"x4'	4'	3
Keystone Patrician	12 9	10 50	10 260	3,462	14 500	W	Box	W		Sd	Fab	Se	ST	WI	Fab		Se	20'x6'6"	6'3"	25
Gipsy Moth 60 G-M	6 70	16 5	1 045	200	1,650	Sp	G	Ad		Sd	Fab	Se	ST	WI	Fab		Se	19x21"		2
Travel Air A-6000-A	15 4	12 5	3,525	900	5,225	Sp	Box	Sp		Tra	Fab	Se	ST	WI	Fab		Se	45x36"	48"	22 0
Travel Air 6000-B	15 0	14 1	2,697	903	5,225	Sp	Box	Sp		Tra	Fab	Se	ST	WI	Fab		Se	45x36"	48"	27 0
Travel Air E-4000	9 55	16 4	1 695	39	2 702	Sp	Ro	Sp		Tra	Fab	Se	ST	WI	Fab		Se	38x30"	38"x30"	9 0
Travel Air 4-D	10 0	12 0	1 837	428	2 060	Sp	Ro	Sp		Tra	Fab	Se	ST	WI	Fab		Tr	38x30"		9 0
Davis D-1	9 1	19 0	840	196	1 358	Sp	Ro	Lm		D	Sd	Fab	Se	ST	WI	Fab				
Davis D-1-K	10 1	14 0	925	197	1,465	Sp	Ro	Lm			Sd	Fab	Se	ST	WI	Fab				
Davis D-1-85	10 0	10 0	954	21	1 381	Sp	Ro	Lm												
Detroit Aircraft Corp.																				
Eastman Flying Yacht	11 15	14 73	1 745	575	2 72	Sp	Box	Sp		Wa	Fab	Se	W	Al	Bo					
Eastman, E-2-A	11 15	14 75	1 960	Var.	2,725		Box	Sp		G	Fab	Se	W	D	Bo					
Lockheed Air Express	14 60	10 20	2 535	1 012	4 575		Box	Sp		G	Fly	G	W	Mo	Ma Fly		G			
Lockheed Vega Model 5-B	15 5	9 5	2 900		4 900								W	Mo	Ma Fly		G			
Lockheed, Sirius	17 35	10 2	2,974	45	4 00	W							ST	WI						
Parks P-1	7 15	23 10	1 531	571	2,07	Sp	Ro	Sp		Fly	G	Fab	Tx	ST	WI	Fab		51x33"		1 3
Ryan B-5	14 3	13 3	2,251	928	4 000	W	G	W		G	Fly	G	Fab	Se	ST	WI	Fab		114"x47"	47"	2
Ryan B-7	15 5	10 2	2 505	950	4 205	W	G	W		G	Fab	Se	ST	WI	Fab	Se			114"x47"	47"	28
Doyle O-2	0 0	20 3	750		1 520															
Driggs, Skylark	7 4	10 4	820	501	1 32	Sp	Sol			D	Sd	Fab	Se	ST	WI	Fab				
Fairchild 42	14 6	14 35	2,220		4 300	Sp	Box			W	G	Fab	Se	ST	WI	Fab		53 "x46"	48"	55
Fairchild 71-A	16 56	13 75	3 150		5 500	Sp	Box			W	G	Fab	Se	ST	WI	Fab		9'x3'	54"	145
Fairchild KR-34 A	9 4	15 5	1 524	380	2 500	Sp	Box			W	G	Fab	Se	ST	WI	Fab				
Fairchild KR-21	9 02	17 02	1,015	210	1 550	Sp	Ro			W	G	Fab	Se	ST	WI	Fab				1 5
Fleet Model 1	8 1	14 37	1 055	211	1 500	Sp	Lnd			D	Ry	Fab	Fk	ST	WI	Fab				
Fleet Model 11	8 08	14 52	1 025	216	1 575	Sp	Lnd			D	Ry	Fab	Fk	ST	WI	Fab				
Fokker AF 10 A	15 5	10 41	7,780	2,320	13 100	Sp	Box			Fly	G	Fly	G	ST	WI	Fab		56x56"	190" x60"	68
Fokker Universal	12 6	14 55	2,482	1 095	4 300	Sp	Box			Fly	G	Fly	G	ST	WI	Fab		56x30	85"x42"	58
Fokker AF-11 A	13 71	12 5	5,045	1,155	7 200	Sp	Box			Fly	G	Fly	G	ST	WI	Fab		D	150"x39"	80
Fokker AF-14	13 10	13 7	4 245	1 652	7 200	Sp	Box			Fly	G	Fly	G	ST	WI	Fab		56x44	114"x50"	50
Fokker AF-32	10 5	10 6	14 910	5,593	24 250	Sp	Box			Fly	G	Fly	G	ST	WI	Fab		50x60	330x100	70
Fokker Super Universal	14 30	13 7	3 250	1 320	5 550		Box			Fly	G	Fly	G	ST	WI	Fab		50x44	180"x42"	96
Ford 4-AT-E	12 90	11 23	8 509	1 725	10,150	D	Ry				Ad	Fly	D	Ry	Ad	Fly	D	47x44	4'9"x16'2"	57''

See page 314 for key

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	WEIGHTS: Wing Loading (Lb. per Sq. Ft.)	WEIGHTS: Power Loading (Lb. per Hp.)	WEIGHTS: Weight Empty with Water if Water Cooled Engine is Used (Lb.)	WEIGHTS: Pay Load (Lb.)	WEIGHTS: Gross Weight (Lb.)	WINGS: Spars: Material	WINGS: Spars: How Fabricated—Section	WINGS: Struts: Material	WINGS: Struts: How Fabricated	WINGS: Covering: Material	WINGS: Covering: How Attached	FUSELAGE OR HULL: Frame-work: Material	FUSELAGE OR HULL: Frame-work: How Fabricated	FUSELAGE OR HULL: Covering: Material	FUSELAGE OR HULL: Covering: How Attached	FUSELAGE OR HULL: Cockpit Dimensions	FUSELAGE OR HULL: Cabin Dimensions	FUSELAGE OR HULL: Minimum Headroom	FUSELAGE OR HULL: Vol. Baggage Comp. (Cu. Ft.)
Ford S-AT-C	16 2	10 7	7 600	5 643	13 500	D	Ry			Ad	Ry	D	Ry	Ad	Ry	42"x44"	4'9"x19'2"	57''	50
Ford 7-AT	15 5	12 6	7 289	5 403	12 910	D	Ry			Ad	Ry	D	Ry	Ad	Ry	42"x44"	4'9"x19'2"	57''	30
Ford 5-AT-C-S	16 2	10 2	8 900	2,558	15 580	D	Ry			Ad	Ry	D	Ry	Ad	Ry	42x44"	4'9"x19'2"	57''	30
General Aviaveal	10 84	19 20	1 522	540	2,110	Sp	Sol	Sp	G	Fab	Se	ST	WI	Fab	Se		7'1"x28'6	4'4''	7 5
General Aviaveal 102-E	13 95	11 6	2 524		2,500	Sp	Lnd	Sp	Fly Tra	Fab	Se	ST	WI	Fab	Se		7'3"x2'11"	4'4''	7 0
General Cadet 111-C	8 66	15 03	1 206		1 241	Sp	Sol	Sp	Fly Tra	Fab	Se	ST	WI	Fab	Se	34"x54"			
Great Lakes 2T 1A	8 45	12 58	1 002	257	1,586	Sp	I	D	Sd	Fab	Se	ST	WI	Fab	Se	25"			
Inland S-300	9 02	19 9	1 265	195	1,202	Sp	Be	W		G	Fab	Se	ST	WI	Fab	Se				
Inland, S-500	10 2		1 918	195	1,490	Sp	Be	T	Sp	GT	Fab	Tx	T	WI	Fab	Tx	40x30"			8
Ireland N-2-B	11 4	10 4	2,900	600	4 300	Sp	Ro		D	Sd	Fab	Se	ST	WI	D	Ry		60x40"	4'	
Ireland N 2-C	15 0	11 5	5 240	900	4 900	Sp	Ro		D	Sd	Fab	Se	ST	WI	D	Ry		60"x40"	4'	
Laird LC-R 300	15 3	10 5	1,922	398	5,010	W	Sol		Sp, Fly	G	Fab	Se	DT	Ry	Fab	Se				
Laird, LC-RT 200	14 4	15 2	1,848	390	2 914	W	Sol		Sp Fly	G	Fab		DT		Fab					
Lincoln PT	6 6	21 9	1,428	198	1 966	Sp					Fab	Se	ST	WI	Fab	Se	24x42			
Lincoln PT-A	6 6	19 6	1 42	220	1 962	Sp			W		Fab	Se	ST	WI	Fab	Se	24x42			
Lincoln PT W	8 0	18 4	1 80	220	1 294	Sp			W		Fab	Se	ST	WI	Fab	Se	24x42			
Mercury Chic	7 9	16 80	935	200	1 515	ST	WI		ST	WI	Fab	Se	ST	WI	Fab	Se	25x42"			
Metal 2-W	13 2	15 81	5 566	1,540	5,000	D	Ry		D	Ry	Fab	Se	ST	WI	D	Ry				
Mahowk Pinto	12 00	16 4	1 135	250	1,900	W	G, Box	Fly		G	Fab	Se	ST	WI	Fab	Se		50x42"		0 3
Mohawk M-1-C	12 00	16 4	1 135	250	1 900	W	G, Box	Fly		G	Fab	Se	ST	WI	Fab	Se		50x42'		0 3
Meso Monoprey	9 0	23 41	785		1,700	W							ST	WI	Fab					
Mono 110	12 3	14 2	1 098	230	1 520	Sp	Sol		Sp		G	Fab	Se	ST	WI	Fab		50"x54	59	4 5
Mono Monocoach	15 95	13 25	1 919	753	3,692	W			Sp			Fab	Se	ST	WI	Fab				
New Standard D-25-A	9 55	14 0	2,055	400	3,442	Sp	Lnd		Fly		G	Fab	Se	ST	WI	Fab	Tx	51x93"		2 5
New Standard D 25-A	9 55	14 0	2,055	710	3,345	Sp			Fly		G	Fab	Tx	D	Ry	Fab	Tx	55x110"		4
Nicholas-Beazley Barling NB-3	8 6	21 12	244	540	1,375	D	Ry		D		Ry	Fab	Se	D	Ry	Fab	Se			
Nicholas-Beazley Barling NB-3V	8 28	25 42	272	540	1,401	D	Ry		D		Ry	Fab	Se	ST	WI	Fab	Se			
Nicholas-Beazley Barling NB-3G	8 55	12 05	7 55	540	3 564	D	Ry		D		Ry	Fab	Se	ST	WI	Fab	Se			
Ogden Gagee	14 4	16 2	2,850	900	4 500	Sp	Box		Sp		Tra	Fab	Tx	ST	WI	Fab	Tx	155"x44"	55"	12
Paramount Cabinaire 165	8 5	15 94	1,620	510	2 650	Sp	Lnd		W		G	Fab	Se	ST	WI	Fab	Se			
Pheasant H-10	0 0	12 25	1 292	600	2,067	Sp	G		Sp		G	Fab	Se	ST	WI	Fab	Se			5
Pitcairn PA 2			1 821	636	3 036	Sp	Be		Sp			Fab	Tx	ST	WI	Fab	Tx			42
Pitcairn 2000-C			1 495	555	2,500															
Pitcairn 2000-Co			1,442	520	2,337															
Simplex Red Arrow K 2-S	11 8	10 0	1 152	120	1 729	W	Box		Sp			Fab	Tx	ST	WI	Fab	Se			
Simplex Red Arrow W-2-S	11 8	16 0	1 150	120	1 779	W	Box		Sp			Fab	Tx	ST	WI	Fab	Se			
Spartan C-3-165	9 0	15 05	1,650	520	2,612	Sp	Sol	Sp	Fly	G		Fab	Se	ST	WI	Fab	Se	30x52		6 0
Spartan C-3-225	9 25	12 0	1 740	580	2 200	Sp		Sol	Sp	Fly	G	Fab	Se	ST	WI	Fab	Se	30x52		6 0
Spartan C-4-225	11 75	15 62	2,325	585	3 515	Sp		Sol	Fly	Sp	G	Fab	Se	ST	WI	Fab	Se		40"x84"	51''	9 05
Star Cavalier C	9 0	21 5	855	200	1 400	Sp		Rol		Sp	G	Fab	Se	ST	WI	Fab	Se				
Star Cavaline	9 02	15 85	919	185	1 425	Sp		Rol		Sp	G	Fab	Ta		WI	Fab	Ta				
Stinson SM-6B	17 1	11 2	5 496		5 550	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40"x92"	40''	
Stinson SM-8 B	15 2	14 2	2 065	539	3,200	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40 x54	40''	2
Stinson SM 6000	17 51	15 5	5 425	2 027	8 500	W		Ro		Sp	G	Fab	Se	ST	Wa	Fab	Se	48x40	65 x40	65	
Stinson SM-8 A Jr	15 2	14 2	2 061	560	3 175	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40 x54"	40''	2
Stinson SM-7 A	15 2	14 2	2,254		3,400	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40 x54"	40''	2
Stinson SM-2-M	14 9	11 2	2,512		3 09	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40 x54"	40''	7
Stinson SM-8-B	15 2	14 2	2 125		3 200	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		40 x54"	40''	7
St. Louis Cardinal C-2-110	9 5	12 2	1 605	566	1 369	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		55 x44"	50''	4 0
St. Louis Cardinal C-2-90	9 5	12 2	996	573	1 569	Sp		Ro		Sp	G	Fab	Se	ST	WI	Fab	Se		55 x44"	39''	4 0
St. Louis Cardinal C-2-65	9 9	25 0	912	598	1,450	Sp		Be		Sp	G	Fab	Se	ST	WI	Fab	Se				
Swallow TP	6 2	20 25	1,260	180	1,620	W		G		W	G	Fab	Se	ST	WI	Fab	Se				
Swallow F-28-Ax	8 3	10 6	1 524	540	2 447	W		G		W	G	Fab	Se	ST	WI	Fab	Se				
Swallow TF-K	5 75	19 0	1 120	170	1 700	W		G		W	G	Fab	Se	ST	WI	Fab	Se				
Swallow TF-W	5 0	15 5	1 201	170	1 739	W		G		W	G	Fab	Se	ST	WI	Fab	Se				
Texas Turpin	10 0	11 25	1 547	2,250	W					G	Fab	Se	ST	WI	Fab	Se				
United Aircraft & Transport Corp																				
Boeing 100	11 8	5 97	1 882	80	2 250	Sp		Box		Sp	Web	Fab	Se	S	D	Wl, Ry	D, Fab	Be, Se	34x45	
Boeing 204	10 02	12 2	5 338	913	5 000	Sp		Ro		Sp	Web	Fab	Se	Fly	G	Se				52"x9'3"
Boeing 40-E-4	13 15	11 57	5 803	1,171	8 000	Sp		Ro		Sp	Web	Fab	Se	ST	WI	D, Fab	Be, Se	32x42"	38"x48"	43''
Boeing 80-A	14 0	11 6	10 442	4,157	15 500	T		Ro		Sp	D	Ry, Fab	Se	T	WI	Fab	Se	63"x42"	63"x19'6"	2''
Boeing Monomail	14 95	13 91	4 610	2,300	8,000	D		Ro		Sd	D	Ry	D	D	S	R v, Wa	D	Ry	42x56	
Hamilton H-45	14 75	13 50	3,639		5 25	D				Ry	T		D	Ry	T	Ad	Ry	D	Ry	Ad
Hamilton H 47	14 75	10 95	3 699		5 275	D				Ry	T		D	Ry	T	Ad	Ry	D	Ry	Ad
Sikorsky S-38	14 3	12 3	4,550	1 900	10,400						D	Ry	Fab							
Sikorsky S-39-A	11 4	13 3	2 658	089	4 00	D		Tra	T	D	Sonl	Fab	Se	D	Sh	Ad	Ry	30x54"	48 x50"	37'3
Sikorsky S-41	19 8	10 0	7,585	2 200	11-500	D		Tra	T	D	Tra U	Fab	Se	D	Sh	Ad	Ry			
Stearman LT-1	12 76	11 98	3 090	1 215	0 25	Sp		Box		Sp	Tra	Fab	Se	ST	WI	Fab	Se	42x37"	38"x80"	12
Stearman C-3-R	9 56	11 47	1,741	400	2 75	Sp		Sol		Sp	Tra	Fab	Se	ST	WI	Fab		30x40"		
Stearman 4-S	12 02	9 52	2,426	629	3 95	Sp		Sol		Sp	Tra	Fab	Se	ST	WI	Fab	Se	50x40		
Stearman 4-C	12 30	12 07	2,258	863	3,800	Sp		Sol		Sp	Tra	Fab	Se	ST	WI	Fab	Se	40x50		
Stearman 4-D	17 58	12 67	2 225	822	3,80	Sp		Sol		Sp	Tra	Fab	Se	ST	WI	Fab	Se	30x46"		
Verville Sport Trainer	9 27	15 6	1 58			Sp		Sol		W	G	Fab	Scw	ST	WI	Fab		30x27"		
Vought 1U-4-B	12 8	15 1	2 10		3 40	Sp		Sol	Re	W	G	Fab	Se	ST	WI	Fab	Se		92x41"	
Viking kittyhawk R 2	8 15	28 1	1 15	557	1 89	Sp		Ra		W	G	Fab	Se	ST	WI	Fab	Se			
Viking kittyhawk B 4	8 05	18 0	1,107	362	1 875	Sp		Ra		W	G	Fab	Se	ST	WI	Fab	Se			
Waco Packard	9 03	10 0	1 814		2,600	Sp		Sol		Sp	Fly G		Fab	Se	ST	WI	Fab	Se	30x32"	
Waco Customaital	9 0	15 0	1,585		2 600	Sp		Sol		Sp	Fly G		Fab	Se	ST	WI	Fab	Se	30x52"	
Waco Model F	7 7		1 150			Sp		Sol		Sp	Fly G		Fab	Se	ST	WI	Fab	Se		
Waco Jacobs	8 5	17 4	1 550		2 44	Sp		Sol		Sp	Fly G		Fab	Se	ST	WI	Fab	Se	50x52"	
Waco 115	9 03	15 25	1,552		2,800	Sp		Sol		W	Web	Fab	Se	ST	WI	Fab	Se			
Waco 225 str w	9 05	11 5	1,82		2,600	W		Sol		W	Tra	Fab	Tx	ST	WI	Fab	Tx			
Waco 225 tap w	11 45	11 50	1 82		2 600	W		Sol		W	Tra	Fab	Tx	ST	WI	Fab	Tx			
Waco Model F-W	7 8	17 2	1,110		1,800	W		Sol	Re	W	G	Fab	Tx	ST	WI	Fab	Tx			
Waco Model F-K	7 8	17 2	1,095		1 900	W		Sol	Re	W	G	Fab	Tx	ST	WI	Fab	Tx			
Warrior Argo	7 95	14 0	1 077	200	1 611	W		Sol		W	G	Fab	Se	ST	WI	Fab	Tx			

See page 324 for key

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	LANDING GEAR: Material	Type	Tread	Wheels Type and Size	Brakes	Shock Unit L. G. and Tail	Tail Wheel	AREA (sq. ft.): Wing	Aileron	Fin	Rudder	Stabilizer	Elevator	PERFORMANCE: High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stall Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
Aeromarine, 22 A	Ht ST	Spl	85'	26x 4	No	Old	No	191	18 2	5 8	2 0	19 5	13 6	88	70	1 650	40	400	6 200	Ms
Aeromarine 26-A	Ht ST	Spl	85'	Aw70x 9	No	Old	No	191	18 2	3 8	2 0	19 2	12 6	90	80	1 650	42	420	10 000	Ms
Aeromarine, 28-B	Ht ST	Spl	82"	Aw70x	No	Old	No	141	18 2	5 8	7 0	19 5	15 6	95	95	1 800	42	200	12 007	Ms
Alexander Eaglerock A-2	ST	Spl Al	6'	Kh26x 4	Ea	Cd	No	287	42 26	4 25	10 18	22 76	16 26	100	85	1 375	55	460	9 000	Ms
Alexander Eaglerock A-12	ST	Spl Al	6'	Kh30x 5	Ba	Cd	No	287	42 26	4 25	10 18	23 76	16 76	116	85	1 700	37	220	12 820	Ms
Alexander Eaglerock A 12	ST	Spl Al	6'	Kh26x 4	Fa	Cd	No	287	42 26	4 75	10 18	75 76	16 76	100	85	1 600	55	470	9 400	Ms
Alexander Eaglerock A 13	ST	Spl	6'	Kh30x 5	Fa	Cd		287	42 6	4 2	10 7	22 8	16 8	119	100	1 700	57	840	14 202	Ms
Alexander Eaglerock Bullet	ST	Can	6'8"	Ba 22x 5	Ba	Ol		180	22 5	3 1	9 7	11 1	0	140	174	1 675	45	700	17 002	Ms
Alexander Eaglerock A 1	ST	Spl	6'	Kh30x 2	Ea	Cd		287	47 8	4 2	10 2	22 8	16 8	150	110	1 850	36	1 080	17 900	Ms
American Aeronautical S 56	ST D		64'	Wi 20x 4	No	Sc	No	261	24 2			17 5	12 5	88	75	1 870	40	400	5 200	Ms
American Aeronautical S-56 B	ST D		64'	Wi 20x 4	No	Cs	No	262	24 0	9 8	0 0	12 5	12 5	93	80	1 700	40	750	8 500	Ms
American Eagle 550	ST	Spl Al	84'	26x 4		Ol	No	212						95	82	1 720	36	700	12000	Ms
American Eagle Phaeton 201	ST	Spl Al	72"	30x 5		Old	No	200						120	110	1 800	35	700	16 000	Ms
American Eagle 201	ST	Spl Al	85"	Aw		Ol	No	222						112	100	1 720	50	700	14 000	Ms
American Eagle D 430	T		70'	30x 5		Old		255	29 6	8 42	10 22	19 78	10 04	125	104	1 772	58	850	16 000	Ms
American Eagle C-450	T		75	30x 5		Old		255	29 1	8 42	10 22	19 78	10 04							
Arrow A2 80L	ST	Spl Al	6 6"	Wi 20x 4	No	Cs	No	183	8 22	2 9	5 8	15 0	10 4	100	82	1 800	50	900	14,000	Ms
Bach 3-CT 8	S	Spl Al	18'	Ba 30x 8	Ba	Ol, Cd	Ol R	538	22 3	5 4	11 62	38 8	23 0	157	152		80	1 100	18 200	Ms
Bach 3-CT 9	S	Spl Al	18'	Bx 20x 8	Ba	Ol Cd	Ol R	550	52 3	5 4	11 62	38 6	25 0	182	158	1 850	80	1 300	20 000	Ms
Bellanca Pacemaker	ST	Spl Al	7'6"	Bx 52x 8	Ba	Old	Pn	275						145	122	1 800		1 000	18,000	Ms
Bellanca CH-300 Seaplane								275						136	110	1.800		620	10 000	Ms
Bellanca Freighter	ST	Spl Al	7 6'	Be 52x 8	Bx	Old	Pn	275						145	122	1.800		900	17 000	Ms
Bellanca Pacemaker	ST	Spl	7'6"	Ba 52x 8	Ba	Old	Pn	275												
Bellanca Skyrocket	ST	Spl	7'6"	Ba 52x 8	Ba	Old	Pn	275						120	120	1 700		1 450	20 000	Ms
Brunner-Winkle Bird Model A	ST				No			200						110	00			700	15 010	Ms
Brunner-Winkle Bird Model B	ST				No			200						110	90			800	10 000	Ms
Buhl CA-8-A	S	Spl Al		Bs 50x 8	Ba	Ol	Yes	402	30 8	5 72	12 02	24 5	24 7	145	120	1 700	45	1 000	16 000	Ms
Buhl CA-8-B	S	Spl Al		Ba 20x 8	Ba	Ol	Yes	402	30 8	5 72	12 05	24 5	24 7	145	120	1,700	45	1 000	16 000	Ms
Buhl CA-6	S	Spl Al		Be 22x 8	Ba	Ol	Yes	512	27 54	4 97	8 7	18 04	18 6	140	115	1 750	45	900	12,000	Ms
Buhl CA-3-D	S	Spl Al		Bx 30x 5	Ba	Ol	Yes	240	81 8	4 7	8 08	15 20	17 9	120	125	1 750	45	900	12 000	Ms
Cessna DC-6-A	ST	Spl Al	8' 8"	Bx 50x 2	Ba	Old	Yes	205	17 0	5 5	9 5	22 2	10 2	101	150	1 700	54	1 400	19 000	Ms
Cessna DC-6-B	ST	Sal Al	8' 6"	Bx 50x 2	Ba	Old	Yes	205	17 0	5 5	9 5	22 2	10 7	148	120	1 700	52	800	17 000	Ms
Command-Aire 3-C-3A	ST	Spl Al	80"	Aw22x1	Gn		No	277	28 0	2 0	7 2	19 0	10 4	102	82	1.200	40		14 350	Ms
Command-Aire 5-C-3Ch	ST	Spl Al	84"	Bx 30x 5	Ba	Cd	No	281	26 0	2 0	7 2	19 0	10 4	124	100	1 600	45		12 320	Ms
Command-Aire 5-C-5AA	ST	Spl Al	84"	Bx 50x 5	Ba	Cd	No	261	26 0	2 0	7 2	19 0	10 4	115	95	1 620	44		15 200	Ms
Command-Aire 5-C-2-C	ST	Spl	84'	Bx 50x 5	Ba	Gr	No	281	26 0	2 0	7 2	19 0	16 4	115	95	1 620	44	5 0	15 200	Ms
Command Aire 3-C-3-A	ST	Spl	84"	Bx 50x 5	Ba	Gr	No	290	13 0	2 0	7 2	15 0	16 4	102	85	1 500	40	4 2	14 250	Ms
Consolidated Commodore								1 000	110 0	25 7	40 2	81 0	54 5							
Consolidated Model 17	S	Spl Al	96'	Bx 56x 8	Ba	Old	AW	260	25 4	15 5	10 58	25 5	12 2	175	150	1 700	62	1 200	18 000	Ms
Consolidated, Model 20	S	Spl Al	96'	Bx 50x 8	Ba	Old	AW	280	35 4	15 5	10 56	25 5	17 2	165	140	1 700	62	1 100	17 200	Ms
Courier P-B-1	ST	Spl Al	6'10'	Kh20x 4	Kh	Ol Cs	No	200	19 0	6 20	7 47	17 70	15 0	102	85	1 850	45			Ms
Crowe Custombilt B5	ST	Spl Al	84'	Wi 24x 4	No	Gr	No	220	22 8	5 7	5 85	15 0	10 2	112	95	1 800	55	720	15 800	Ms
Cunningham-Hall PT 6	ST	Spl Al	94'	Ba 52x 6	Bx	Aer Sc	Op	330	31 0	7 5	13 0	29 5	22 5	155	110	1 675	29	1,020	12 200	Ms
Curtiss-Wright Corp.																				
Curtiss Carrier Pigeon	ST	Spl Al			Yes	Ol														
Curtiss Fledgling C2	ST	Spl Al				Ol														
Curtiss Fledgling K2	ST	Spl Al				Ol														
Curtiss Condor	ST	Trsd			Yes	Ol	Yes	1 212	241 4		53 0		47 6		118			878	17 000	Ms
Curtiss Robin OX-5	ST	Spl Al	94"	26x 4	No	Ol	No	207	22 5	5 4	9 7	22 2	10 8	101	85	1 100		400	10 200	Ms
Curtiss Robin C-1	ST	Spl Al	96"	Ba 28x 4	Ba	Ol	No	207	22 5	5 4	9 7	25 2	10 0	120	101	1 530		840	12 700	Ms
Curtiss Robin J-1	ST	Spl Al	97	Bx 28x 4	Bx	Ol	No	202	22 3	5 4	9 7	25 2	16 0	120	101	1 700		720	15 200	Ms
Keystone Air Yacht	Ht ST	Spl Al	2 10	26x 8	No	Aer	No	512	80 6	27 4	10 7	57 0	27 0	139	105		55	810	15 500	Ms
Keystone Commuter	Ht ST	Spl Al	7 9	20x 2	No	Ol	No	457	30 8	20 8	10 3	40 0	22 0	117	97		50	850	12,000	Ms
Keystone Patrician	ST	Spl Al	19' 0"	44x10		Ol	Yes	920	64 0	77 0	51 9	62 8	40 4	144	120		56	1 080	14 200	Ms
Gipsy Moth 60-GM	ST	Spl Al	80"	24x 4	No	R	No	215	22 2	2 78	9 42	15 24	12 4	102	82	1 040	42	700	18 000	Ms
Travel Air A 6000-A	Ht S	Spl Al	101"	Ba 50x 8	Ba	Ol Cs	Pn	240	22 5	6 5	12 5	55 1	21 7	140	110	1 200	65	1 000	18,000	Ms
Travel Air 6000-B	Ht S	Spl Al	101"	Ba 34x 8	Ba	Ol Cs	Pn	282	30 4	0 3	13 2	32 1	71 2	121	110	1 200	62 0	800	16 000	Ms
Travel Air E-4000	Ht S	Spl Al	78"	Ba 30x 5	Ba	Sc	No	209	19 5	4 5	9 2	16 0	16 0	122	102	1 200	24 7	600	15 000	Ms
Travel Air 4-D	Ht S	Spl Al	84"	Bx 50x 5	Ba	Ol Cs	No	289	19 5	4 2	9 2	71 7	12 1	120	100	1 700	56 7	950	18 000	Ms
Davis D-1	ST	Spl Al	78"	Kh		Sc		145						101	82	1 600	58	500	12.000	Ms
Davis D-1-K	ST	Spl Al	78"	Kh				145						128	105	1 800	40	1 000	14,000	Ms
Davis D-1-85	ST	Spl Al	78"	Kh		Sc		145						112	97	1 700	50	720	13,000	Ms
Detroit Aircraft Corp.																				
Eastman Flying Yacht								207	16 5	6 1	9 57	22 4	10 0	102	80		50	225	14 000	Ms
Eastman E-2-A	ST		25½			Hyd	None	244	16 5	6 14	8 57	22 4	10 0	101	82		50	222		Ms
Lockheed Air Express	ST	Spl Al	8'	Bx	Bx	Ol Cd	Yes	280	22 0	10 6	8 5	59 0	25 5	175	140		55	1 200	18,000	Ms
Lockheed Vega Model 5B	ST	Spl Al	8	Bx	Bx	Ol Cd	Yes	275	25 0	10 6	8 5	51 5	10 0	165	150		60	1 200	20 000	Ms
Lockheed Sirius			144"	Bx	Ba		No	242	25 0	11	15 0	59 0	25 5	175	140		55	1 000	20 000	Ms
Parks P-1	ST	Spl Al	88"	Wi 26x 4	No	R	No	290	77 28	4 8	7 2	27 4	16 9	95	72	1 272	55	200	11 000	Ms
Ryan B-5	ST	Spl Al	10'	Ba 52x 8	Ba	Aer	Pn	280	24 4	16 2	5 7	26 0	16 5	140	110	1 220	25	1 000	18 000	Ms
Ryan B-7	ST	Spl Al	10'	Ba 52x 6	Ba	Aer	Pn	280	24 4	6 4	11 1	77 5	17 5	150	170	1 700	70	1 550	20 000	Ms
Doyle O-2	ST	Spl Al			No		No	162												
Driggs Skylark	ST	Spl	72"	Wi		Old R		160	19 4	5 0	2 5	15 0	10 4	90	82	1 050	45	600	14 000	Ms
Fairchild 42	ST	Spl Al	8' 0"	Ba 52x 6	Bx	Ol	Yes	290	24 8	4 0	11 0	30 0	24 5	120	105	1 700		700	15 200	Ms
Fairchild 71 A	ST	Spl Al	7' 6"	Ba 52x 8	Ba	Ol	Yes	552	34 0	4 0	11 0	30 0	24 5	155	110	1 700		675	15.500	Ms
Fairchild KR 34A	ST	Spl Al	71"	Ba 28x 4	Bx	RD	No	285	36 4	4 0	7 5	20 2	16 9	175	105			800	14 100	Ms
Fairchild KR 21	ST	Spl Al	5' 4"	Kh24x 4	No	RC	No	195	17 5	4 4	5 5	12 9	8 6	115	90			772	15,000	Ms
Fleet Model I	ST	Spl Al	64"	Wi 26x 5	Op	Ol	No	187	11 8	1 6	8 1	15 1	4 8	106	80	1 620	46	730	15 070	Ms
Fleet Model II	ST	Spl Al	64"	Wi 26x 5	Op	Ol	No	187	11 8	1 6	8 1	15 1	4 8	106	40	1 650	46	250	13 020	Ms
Fokker AF 10A	S	Spl Al	106"	Sa 44x10	Sa	Cd	No	794	60 0	19 0	20 5	41 8	44 0	[illegible]	420	4 200	90	1,190	48 000	G4
Fokker Universal	S	Spl Al	120"	Sa 32x 6	Sa		No	521	20 0	2 21	11 67	22 9	20 0	120	105	1 200	52	870	14 000	Ms
Fokker AF 11A	S	Spl Al	122"	Bx 56x 8	Ba	Cd	No	514	36 0	28 0	18 0	34 0	36 0	112	100	1 620	55	700	11 000	Ms
Fokker AF 14	S	Spl Al	162"	Bx 56x 8	Ba	Gr R	No	514	26 0	4 6	12 5	26 6	34 7	137	110	1 650	42	710	14 300	G4
Fokker AF 32	S	Trsd	240"	Bx 58x14	Ba	Gr	Pr	238	81 7	30 4	26 0	90 0	77 4	148	125	1 720	65	820	13 000	Ms
Fokker Super Universal	S	Trsd	124"	Sa 52x 6	Sa	Cd	No	364	22 4	2 21	11 42	25 70	20 0	150	118	1 650	26	850	18,000	Ms
Ford 4-AT E	ST	Trsd	201"	Wi 56x 8	Hyd	Aer	Pn	755	22 8	11 7	24 7	51 5	59 2	152	107	1 700	57	920	16,300	Ms

See page 314 for key

SPECIFICATIONS OF AMERICAN COMMERCIAL AIRPLANES

Including only planes with Approved Type Certificates—AVIATION does not assume responsibility for the figures given

Manufacturer	LANDING GEAR: Material	Type	Tread	Wheels Type and Size	Brakes	Shock Unit L. G. and Tail	Tail Wheel	AREA (sq. ft.): Wing	Aileron	Fin	Rudder	Stabilizer	Elevator	PERFORMANCE: High Speed (M.P.H.)	Cruising Speed (M.P.H.)	R.P.M. at Cruising	Stall Speed (M.P.H.)	Climb at Sea Level F.P.M.	Service Ceiling (Ft.)	Performance Basis
Ford 5-AT-C	ST	Trsd	223"	Wi 36x 8	Hyd	Aer	Pn	783	52 0	11 7	24 2	65 3	46 8	152	122	1 200	64	1 300	16 500	Ms
Ford 2 AT	ST	Trsd	223"	Wi 36x 8	Hyd	Aer	Pn	783	52 0	11 7	24 2	65 3	46 8	124	110	1 700	60	850	14 100	Ms
Ford 5-AT-C-S	ST		172"					783	52 0	11 7	32 0	65 3	46 8	150	104	1 200	64	900	14 200	Ms
General Aristocrat	D	Spl Al	7' 0"	Bx 30x 5	Bx	R Com	Yes	195	19 5	1 82	7 47	11 24	10 13	110	90	1 620	40	650	12,150	Ms
General Aristocrat 102-E	D	Can	7'	Bx 30x 5	Bx	R Com	Yes	199	21 2	2 66	7 64	11 24	10 92	122	110	1 670	45			Ms
General Cadet 111-C	D	Can	7'	Bx 30x 5	Bx	R Com	Yes	201	19 46	1 82	7 47	11 24	10 92	110	95	1 620	40			Ms
Great Lakes 2T 1A	S	Spl Al	70"	Wi 24x 4	Bx	Ol	No	171	16 6	3 5	5 7	13 46	9 5	106	90	1 950	50	545	15,010	Ms
Inland S-300	Wi, ST	Spl Al			No	Hyd	No	144						110	90					Ms
Inland, W 500	ST	Spl Al	7' 2"	Kh 24x 4	A.P	Old	Yes	119	25 0	5 8	6 1	13 0	8 9	155	100	1 853	40	1 000	18 000	Ms
Ireland N-2-B	ST	Spl Al	2'10"	Bx 32x 6	No	Ol	No	370	53 2	15 62	18 2	19 13	25 8	115	85	1.750	46	620	14 000	Ms
Ireland N-2-C	ST	Spl Al	7'10"	Bx 32x 6	No	Ol	No	370	55 2	15	18 2	27 13	25 8	120	100	1 720	47	1 000	16,000	Ms
Laird LC-B 200	S	Spl Al		Bx	Bx	RCd		202		15 0		26 0		165	155		55	1 200	20,000	Ms
Laird LC-RJ 200	S	Spl		Bx	Bx			202		15 0		26 0		150	120		55	1 200	19 000	Ms
Lincoln PT	S	Spl Al	76"	26x 4	No	R	No	292	30 5	4 2	8 5	17 5	10 0	101	82		52	800	11 000	Ms
Lincoln PT K	S	Spl Al	76"	26x 4	No	R	No	292	20 5	4 7	0 5	17 5	16 0	104	85		52	820	15 500	Ms
Lincoln PT W	S	Spl Al	76"	26x 4	No	R	No	292	20 5	4 7	8 5	17 5	16 0	100	87		52	870	14 000	Ms
Mercury Chic	ST	Spl Al	77 2	Kh24x 4	No	Sc R	No	193	54 0	6 9	5 0		18 0	112	90	1 750	40	900	10 000	Ms
Metal C 2 W					Yes	Aer		380						125	111			510	11 200	Ms
Mohawk Pinto	Ht S	Spl Al	101"	Ba 24x 4	Ba	Aer	No	142	11 9	5 5	6 7	15 5	11 12	115	98	1 888		1 100	15 000	Ms
Mohawk M 1-C	Ht S	Spl Al	101"	Bx 24x 4	Ba	Aer	No	145	11 9	5 5	6 7	15 5	11 12	171	108	1 922		1 200	16 000	Ms
Mono Monoprep	Ht S	Spl Al				Ol Cs														
Mono, 110	S, Ht	Spl Al	65	8 5x1	A.P	Old	Yes	152 5	15 5	4 1	2 0	10 6	9 2	138	116	1 050	46	1 200	18 000	Ms
Mono Monocoach	Ht S	Spl Al			Bx	Ol Cs		122						155	112			1 700	16 000	Ms
New Standard D-29-A	ST	Spl Al	78"	Kh26x 4	No	Old Rea	No	242	10 7	5 8	9 9	19 5	15 5	98			80	900	10,800	G4
New Standard D-25-A	ST	Spl Al	98	Sa 30x 5	Sa	Old Sc	Pn	550	26 0	8 5	12 0	55 2	19 7	110	95		48	750	11 000	Ms
Nicholas-Beazley Barling NB 3	ST	Spl Al	6' 9"	24x 4	No	RCd	No	160	0 0	5 4	5 2	4 5	9 0	105	87		42	800	12,000	Ms
Nicholas-Beazley Barling NB-3N	ST	Spl Al	6' 9"	24x 4	No	RCd	No	180	0 0	2 4	5 2	9 5	9 0	105	82		45	800	12 000	Ms
Nicholas-Beazley Barling NB-3G	ST	Spl Al	6' 9"	24x 4	No	RCd	No	180	0 0	2 4	5 2	9 5	9 0	110	92		45	800	17 500	Ms
Ogden Osprey	ST	Spl	100"	Ba 52x 8	Ba	Old	Pn	280	28 0	9 2	9 5	24 0	17 5	150	102	1 820	65	650	15,000	Ms
Paramount Cabinaire 165	ST	Spl Al	7'2"	Ba 30x 5	Ba	Ol	Sol	285	24 0	4 75	9 75	18 0	10 0	120	105			850	12,000	Ms
Pheasant H-10	ST	Spl Al	2' 8"	D 22x 8	No	Sc	No	118	15 0	5 0	5 5	8 0	5 2	111	90	1.725	35	500	12,500	Ms
Pitcairn PA-7	S	Spl Al	78"	Ba 50x 5	Ba	Cr		222	20 0	4 2	8 2	12 4	12 5	145						Ms
Rearwin 2000-Co				Pa 28x 4	Ba															Ms
Rearwin 2000-C				Ba 28x 4	Ba	R, Ol														Ms
Simplex Red Arrow K 2-S	ST	Spl Al		20x 4	Op	Old, Sc		150	18 0	5 0	5 5	9 4		125	110			1 000	12,000	Ms
Simplex Red Arrow W 2-S	ST	Spl Al		26x 4	Op	Old, Sc		120	18 0	3 0	15 1	9 4								
Spartan C-3-165	ST	Spl Al	85"	Ba 50x 2	Ba	Cs Hyd	Op	280	25 0	2 5	7 8	20 6	15 0	171	100	1 720	47	820	12 000	Ms
Spartan C-3-225	ST	Spl Al	85'	Ba 30x 5	Ba	Cs Hyd	Op	246	25 0	8 12	7 8	25 6	10 0	180	110	1 750	60	1 180	15 900	G4(x
Spartan C-4-225	ST	Spl Al	120"	Ba 52x 8	Ba	Cs, Hyd	Pr	280	18 5	7 0	15 5	15 5	13 3	120	109	1 750	49	982	14 200	Ms
Star Cavalier C	ST	Spl Al	81"	Aw22x10		Cs		159	17 82					100	90	2 000	58	800	10 000	Ms
Star Cavalier	T	Ol	84"	Ba 24x 4	Bx	Ol, Cs		159	17 85	4 0	7 5	14 9	9 8							Ms
Stinson SM-6B	ST	Spl Al	114"	Bx 52x 8	Ba	Own	Pn	500	54 0	9 0	11 7	27 1	22 3	145	120	1 720	59		10 000	Ms
Stinson SM 8B	ST	Spl Al	115"	Wi 50x 5	Kh	Own	Pn	208	22 4	5 2	11 8	25 3	25 3	152	110	1 720	55			Ms
Stinson SM 6000	ST	Spl Al	204	Bx 54x 8	Bx	Aer	Pn	490	42 0	10 0	10 0	42 2	23 0							
Stinson SM-8A Jr	ST	Spl Al	112"	Wi 50x 5	Kh	Own	Pn	208	22 4	5 2	11 6	23 5	25 3	128	104	1 700	55			Ms
Stinson SM-7A	ST	Spl Al	112"	Wi 30x 5	Kh	Own	Pn	204	24 5	2 2	11 5	23 5	18 0	144	116	1,750	58			Ms
Stinson SM 7B	ST	Spl	115'	Wi 30x 5	Kh	Own	Pn	209	24 5	2 2	11 0	23 5	18 0							Ms
Stinson SM-8B	ST	Spl	115"	Wi 30x 5	Kh	Own	Pn	208	22 42	2 1	1 0	25 5	75 5							Ms
St. Louis Cardinal C-2-110	S	Spl Al	75"	Wi 26x 4	Own	Old	No	180	15 0	4 1	4 0	12 5	8 7	125	110	1 800	45	1 100	15 000	Ms
St. Louis Cardinal C-2-90	S	Spl Al	75"	Wi 26x 4	Own	Old	No	100	15 0	4 1	4 8	12 5	8 7	110	102	1 800	45	90	13 500	Ms
St. Louis Cardinal C-2-65	S	Spl Al	75"	Wi 26x 4	Own	Old	No	180	15 0	4 1	4 8	12 5	8 7	105	90	1 800	42	600	12,000	Ms
Swallow TP	S	Str Al	72"	28x 4		Sc		280	20 0	5 6	7 0	14 0	16 5	90	80	1 520	45	700	10 000	Ms
Swallow F 28-Ax	S	Spl Al	72"	55x 5	Be	Sc		272	20 0	3 0	8 5	12 5	16 5	110	90	1 625	42	800	14 100	Ms
Swallow TP K	S	Str Al	77	76x 4		Sc		280	20 0	3 2	2 0	14 0	16 5	100	85	1 650	42	800	16,200	Ms
Swallow TP W	S	Str Al	72'	76x 4		Sc		260	20 0	5 5	7 0	14 0	16 5	100	85	1 050	42	800	10 200	Ms
Texas Temple	S	Spl Al						225												
United Aircraft & Transport Corp.																				
Boeing 100	S D	Str Al	75"	Bx 50x 5	Ba	Ol	No	220	15 0	1 8	8 2	19 9	15 4	165	140	1 800	52			Ms
Boeing 204								470	50 4	14 5	17 1	28 0	28 0	155	110	1 825	50			Ms
Boeing 40-B-4	ST	Str Al	7' 80"	Ba 56x 8	Ba	Ol	No	545	26 0	8 4	12 9	45 2	28 2	158	110	1 600	58	800	16,500	Ms
Boeing 80-A	ST	Trsd	710"	Ba 54x12	Bx	Ol & Cs	Ol&Sol	1,250	101 0	14 5	26 0	66 0	50 0	158	115	1 500	57	600	15 500	Ms
Boeing Monomail	S	Spl Al	10'1"	Bx 56x 8	Bx	Ol	Yes	495	42 0					128	137	1 200		820	14,000	Ms
Hamilton H 42	HtS	Spl Al	102"	Bx 52x 8	Ba	Aer R	Pn	390	24 2	8 6	11 9	31 5	20 9	135	115	1 620	20	850	15 000	Ms
Hamilton H 47	HtS	Spl Al	162"	Bx 22x 8	Ba	Aer, R	Pn	390	24 2	8 6	11 9	31 5	20 9	145	122	1 850	55	900	12 000	Ms
Sikorsky S-38	ST	Olea	116	36x 8	Own	Hyd	No	720	42 5	15 0	20 0	21 4	35 5	128	110	1 650	52	750	18 000	Ms
Sikorsky S-39-A	S	Hyd	120"	Go	Own	AW Olea	Pn	320	20 0	4 8	12 0	27 2	18 4							Ms
Sikorsky S-41	S	Hyd	140"	Go 40x10	Own	Ol Sp	Sol	869	80 0	12 0	27 0	80 5	54 2							Ms
Stearman L T-1	ST	Spl Al	96"	Ba 56x 8	Ba	Aer	Pn	480	29 6	9 2	14 1	50 0	28 0	140	110	1.700	50	900	15 000	Ms
Stearman C-3-R	ST	Spl Al	90"	Kh50x 5		Ol R	No	206	27 0	4 6	9 6	25 0	14 6	152	110	1 200	47	1 000	10 000	Ms
Stearman 4-E	ST	Spl Al	96"	Bx 20x 5	Ba	Aer	Pn	264	25 1	6 84	11 2	27 2	16 0	150	150	1 700	55	1 400	18 000	Ms
Stearman 4-C	ST	Spl Al	90"	Bx 20x 5	Ba	Aer	Pn	264	25 12	6 84	12 42	27 42	12 02	142	110	1 700	55	1 000	12 000	Ms
Stearman 4-D	ST	Spl Al	90"	Bx 20x 2	Bx	Aer	Pn	284	25 12	6 84	12 47	22 42	12 02	142	115	1 700	55	1 000	12 000	Ms
Verville Sport Trainer	ST	Spl Al	78"	7 5x10	Yes	Old	Sol	242	22 6	5 06	9 27	16 6	12 5	120	95	1 800	40	850	15 000	Ms
Verville 104-?	ST	Spl Al	96"		Bx	Old	Pn	246	25 7	5 0	11 0	25 0	12 0	120	100	1 700	48	950	18 000	Ms
Viking Kittyhawk B-2	ST	Spl Al	86"	Kh 26x 4	Op	R Cont	No	255	27 5	5 68	6 56	24 04	12 04	110	95	1 800	56	1 200	15 000	Ms
Viking Kittyhawk B-4	ST	Spl Al	86'	Kh 28x 4	Op	R Cont	No	253	22 3	5 68	6 56	24 04	12 04	110	95	1 650	56	1 200	15 000	Ms
Waco Packard	ST	Spl Al	78"	Bx 50x 5	Bx	Ol	No	288	20 7	4 9	7 0	19 5	16 5	124	105			1 000	18 000	Ms
Waco Continental	ST	Spl Al	78"	Bx 30x 5	Bx	Ol	No	288	20 2	4 9	2 0	19 5	16 5	116	98			800	16,000	Ms
Waco Model F	ST	Spl Al	76'	6 50x10	A P	Ol	Pn	241	22 0	4 5	2 0	12 0	15 5	110	98	1 750		720	14 000	Ms
Waco Jacobs	ST	Spl Al	78"	Bx 30x 5	Ba	Ol	No	288	20 7	4 9	2 0	19 5	16 2	106	95	1 250		650	12 000	Ms
Waco 165	ST	Spl Al	78"	Ba 50x 5	Ba	Aer, Gr	No	288	22 6	4 06	7 0	19 5	15 88	120	102			700	18,000	Ms
Waco 225 str. w	ST	Spl Al	78"	30x 2	Bx	Hyd		288		4 06	7 0	16 1	14 25	120	102			1 200	19,000	Ms
Waco 225 tap. w	ST	Spl Al	78"	30x 2	Ba	Hyd		227		4 06	7 0	16 1	14 75	150	112	1,750	40	1 500	19 000	Ms
Waco Model F W	ST		76"	6 50x10	Aer	Ol	Pn	241		4 4	7 0	12 0	15 50							Ms
Waco Model F K	ST		76"	6 50x10	Aer	Ol	Pn	241		4 2	7 0	17 0	15 50							Ms
Warrior Aero	S	Spl Al	6'	Ba 20x 5	Yes	R	No	305	20 6	3 0	5 2	12 2	11 7	128	108	1,750	47	850	16,000	Ms

(a) Section IV., Dept of Com. Aero Bulletin No. 7 A

See page 314 for key

SPECIFICATIONS OF AIRPLANES NOT HAVING GROUP I TYPE CERTIFICATES

AVIATION does not assume responsibility for the figures given

Manufacturer	Designation		Price at Factory	Type	Number Seats	Power Plant	Total HP	Span (Ft.)	Wing Area (Sq. Ft.)	Length Overall (Ft.)	Height Overall (Ft.)	Weight Empty (Lb.)	Pay Load (Lb.)	Gross Weight (Lb.)	Normal Range (Miles)	Wing Const.	Fuselage Const.	High Speed (M.P.H.)	Service Ceiling (Ft.)	Type of Control	Brakes	Type of Shock Absorber	Type Certificate Static
Aeronautical Corp. of Amer.	Aeronca C-2	—	$1,495	OML	2	1 Aeronca E-127	38	36'	144	20"	7 — 4"	325	150	700	315	W-Fab	WI-ST	85	16,500			JL	Apl
Arrow Aircraft & Motors Corp.	A2-100A	—	2,195	OML	2	1 Ac	125	25	193	19"	8 — 5"	1 064		1 550	300	W-Fab	WI-ST	110	16 000	Stk	N-a	Co	11*
Bird Wing Commercial Aircraft Co.	Imperial No. 10	—	16 500	OBL	3	1 Wr J 6-5	305	34'	1 459	2'	9 — 7	2 220	372	4 665	625	W-Fab	WI-ST	125	15 000	Stk	Ex	Ol	II
Buhl Aircraft Co.	Airsedan	—		OBL	4	1 Pew	420	46'				4 665		6 665	660	W-Fab	WI-ST				Bx	Ol	II
Chance Vought Corp.	Corsair	—		OBL	2	1 Pew	420		320	28'	11' 4"	2 800		5 000	600	W-Fab	WI-ST	140	22,500	Du			
Chance Vought & Mator Co.	Corsair Seaplane	—		OBL	2	1 Pew	450	34' 6"	345	28'	10' 4"	3 000		5 324	442	D Fab	ST-Stak Fab	135	14 200	Wh, Fe			
Curtiss Aircraft Co.	Falcon	—	23 900	OML	3	1 (2) Cy Ch	510	57	446	33' 4"	11' 4"	4 625	1 130	7 000	1 000	W-Fab	WI-ST			Du	Br	Gr	II
Curtiss Aircraft Co.	Condor	—	6 810	OML	2	1 Cy	600	56	1 460	41'	11' 1"	7 755	950	12 250	1 250	W-Fab	WI-ST	146	19,000	Stk	Br	Ol	II
Curtiss Aircraft Co.	Condor Sport	—	4 375	OML	2	1 Cy	290	49	1 029	29'	9' 1"	3 250	200	4 650	520	W-Fab	WI-ST	118	22,000	Du	Br	Ol	II
Curtiss Aircraft Co.	Condor Sport A	—	4 375	OML	2	1 Cy	290	49	1 029	29'	9' — 6"	3 250	200	4 650	560	W-Fab	WI-ST	118	22,000	Du	Br	Ol	II
Detroit Airplane Co., Inc.	Detroiter	—		OML	1	1 Menasco	27	25"	110	12'	4' 6"	280		390	270	W-Fab	WI-ST	78	12,500	Stk	Br	Ol	
Inda Aircraft Co.	FA-1	—	1 075	OBL	1	1 Irvin 79	23	20	105	14"	5' 9"	300	50	500	250	W-Fab	W-ST	D 85	15,000	Stk	Ni	R	
Mid-Continent Aircraft Corp.	C-2-B	—	23,500	CMC	6	1 Wr.	510	58'	360	32' 10"	9' 6"	3 660	1 440	6 500	500	D	W-ST	140	14 000	Wh	Ni	Aer	II
Overmeier Aircraft, Inc.	OC-12	—	3 600	OML	3	1 OX-5	90	34'	240	22'	8' —	1 410	400	2 490		W-Fab	WI-ST			Du	Br		
Overmeier Aircraft, Inc.	OC-13	—		OML	3	1 Continental	165	34' 6"	240	22'	8' —	1 410	400	2 490		W-Fab	WI-ST			Du	Br	Ap	
Overmeier Aircraft Corp.	OC-14 Challenger 110	—		OML	4	1 Wr	110	33' 2"	330	24'	9' —	1,552	660	2,294	465	W-Fab	WI-ST	103	9 000	Stk	Br	En	Apl
Paramount Aircraft Corp.	A-70	—	5 950	CBL	4	1 Cu	165	35" 2"	205	24' 7"	9' —			2 600	360	W-Fab	W-ST			Du	Br	Ol	II
Rhoades Aircraft Co., Inc.	Traveler A-1	—	1 495	CML	1	1 Cro.	53	31' 6"	110	20' 8"	6' 3"	578	115	950	510	W-Fab	W-ST	106	12,500	Stk	Ni		
Ryan Aircraft Corp.	Foursome C-1	—	10 700	CML	4	1 Wr J 6	225	39' 3"	220	27' 7"	9' 9"	2,000	660	3 000	625	W-Fab	W-ST	150	16,000	Stk	Br	Ol	
Sedeley Aircraft & Engine Co.	Flying Dutchman	—	2 000	OMC	1	1 Sz	40	26	100	18"	6' 6"	531	231	900	360	W-Fab	W-ST	90	17,000	Stk	Na	Rou	
Taylor Aircraft Corp.	CP Chirp	—	5 995	CML	2	1 Cir	90	34'	165	22' 10"	7' 6"	1,022	212	1 446	455	W-Fab	W-ST	110	15,000	Stk	Ob	Gil	
Whitelaw Mfg. Co.	Avia	—	4 895	OBC	2	1 Cir	90	27'	154	24'	8' 6"	810		1 470	330	W-Fab	W-ST	120	15,000	Du	Na	Gil	
Wichita Aircraft Co.	Skyhark	—	3 595	OML	3	1 Cro	90	34'	240	24' 6"	8' 6"	1,400	340	2,455	330	W-Fab	W-ST	125	15 000	Du	Br	Gr	
Zenith Aircraft Corp.	Z-6-A	—		OBL	2	1 Pew	420	46'	450	31'	10' 5"	2,655	1 820	4,396	500	W-Fab	WI-ST				Ba		

CANADIAN

Curtiss Reid Aircraft Co. Ltd.	Rambler	—	4 700	OQL	2	1 Cy	100	33'	230	23' 2"	8'	1 010	415	1 250	310	D-Fab	W-ST	102	12,000	Du	Stk	N-a	R
Curtiss Reid Aircraft Ltd.	Rambler	—	4 200	OQC	2	1 Hermes	115	33	230	23 2	8	1 060	355	1 650	270	D-Fab	W 1-Fr Fab	105	13 500	Du	Stk	N-a	R

A —Amphibion
Ad —Abloid
Air —Aerol
Ar —Arrow
Am —Aramel
Apl —Aprilaire
Ar —Arrowbile
B —Bigbain
Bak —Bakelite
Bel —Bellanca
Bo —Bolled
Boe —Boe ejgar
Br —Brewsbask
Bm —Bird Monitor
Bw —Bird Wing
Bu —Buhl
Ch —Chance Vought
Co —Condor
Cor —Corsair
Cu —Curtiss
D —Detroiter
Du —Duplane
E —Eaglerock
Ex —Explorer
F —Falcon
Fab —Fabrik
Fo —Fokker
G —Gallaudet
Gc —Gee Bee
Gl —Gull
Gr —Grumman
Gu —Guggenheim
Gy —Gypsy
H —Hamilton
Ha —Hanseatic
Hi —Hispano
Hk —Hawk
Hs —Heath Parasol
Hy —Hyatt Skimmer
Ir —Irvin Airchute
Is —Isaacs
J —Jacobs
K —Kreider-Reisner
L —Lincoln
Le —Lee
Lam —Lambert
Lan —Lanzen
Li —Liberty
Lk —Leakbird
Lm —Lamson
Lo —Loening
M —Monocoupe
Ma —Marlin-Rockwell
Mc —McClintock
Mo —Morrison
N —Nicholas-Beazley
Na —Navigation
O —Ospa
Ol —Oldsmobile
Old —Oldmobile
OX-5 —Curtiss
P —Packard
Pa —Parks
Pit —Pitcairn
Pk —Pratt & Whitney
Pr —Pratt & Whitney Jr.
Pw —Pratt & Whitney Wasp
Ra —Ranger
Re —Reed
Ro —Rotary
Rw —Rearwin
Ry —Ryan
S —Stearman
Sa —Salmson
Se —Sensenich
Sh —Shawmut
Sp —Spartan
St —Stinson
Su —Sunbeam
Sz —Szekely
Th —Thomas
Tm —Timmerman
Tr —Travelair
Trod —Trodair
Tw —Twin Beech
W —Wood
Wa —Waco
Wb —Wasp Bantam
Wc —Warner Scarab
Wd —Warner Super Scarab
Wh —Wheeler
Wi —Wicks
Wk —Weiland
Wl —Wilson
Wr —Wright
Ww —Wright Whirlwind
Y —Yankee
Z —Zenith
1 —Without cantilever
2 —Cantilever
3 —Semi-cantilever
4 —Parasol and sesqui
5 —Solid
6 —Semi-solid
7 —Split
8 —Standard
9 —Tandem
10 —Side-by-side
11 —Stagger
12 —Skeleton
13 —Steel
14 —Metal-covered
15 —Steel
16 —Fabric-covered
17 —Monocoque
18 —Shock Cord
19 —Sprung
20 —Semi-sprung
21 —Push Rod
22 —Sprung Pivot
23 —Pivoted
24 —Rigid
25 —Wood
26 —Metal
27 —Metal and wood
28 —Wood
29 —Without cantilever
30 —Cantilever
31 —Semi-cantilever
32 —Without cantilever

FAMOUS FLIGHTS WITH THOMPSON VALVES

(This advertisement is one of a series recalling historic airplane flights in which Thompson Valves were used.)

With the winners of the DOLE HONOLULU RACE

ONE of the most noted competitions in the history of aviation was the Dole Honolulu Race in 1927. Starting from Oakland, California, eight daring planes set their course for the tiny island of Hawaii . . . 2400 miles over the Pacific.

The successful landing of the winner, the "Woolaroc," 26 hours later in Honolulu brought highest tribute from all the world . . . to the navigating skill of the pilots, Arthur Goebel and W. V. Davis . . . and to the reliability of the "Woolaroc's" Wright Whirlwind engine.

Largely instrumental in the perfect performance of the motor were the 18 Thompson Valves that sturdily withstood terrific stresses and burning engine temperatures during the flight.

The unvarying dependability of Thompson Valves in this and many other important flights has influenced their adoption as standard equipment in today's finest American airplane motors.

THOMPSON PRODUCTS, INCORPORATED
General Offices: Cleveland, Ohio, U. S. A.
Factories: CLEVELAND and DETROIT

Thompson Valves

KELSEY-HAYES WHEELS FOR AIRCRAFT

Packard-Diesel Powered Waco— Official Ship of the National Air Tour

Edward R. Macauley, Sales Manager of Diesel Aircraft Engine Division of Packard, extending best wishes to Walter Lees, pilot, at start of National Air Tour. Capt. Ray Collins is in the front cockpit.

A Packard-Diesel powered Waco was selected as the official ship of the 1930 National Air Tour. Piloted by Walter Lees and carrying Captain Ray Collins, Manager of the tour, this ship with its oil-burning powerplant created enormous interest wherever the tour stopped.

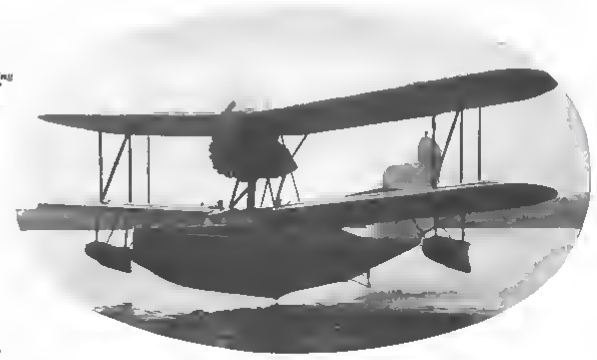
And why not? Here was a 225 H. P. engine carrying two men and their baggage at 100 miles an hour, unfailingly, day after day, over 4,935 miles of mountain, plain and desert *at a fuel cost less than that required to drive a Ford car!* Three-quarters of a cent a mile was the cost of the 437 gallons of furnace oil burned on the tour!

Nor was economy the only feature. Its safety, too, was recognized by everyone as being a factor of first importance. The Waco's tanks carried *fire-safe* fuel.

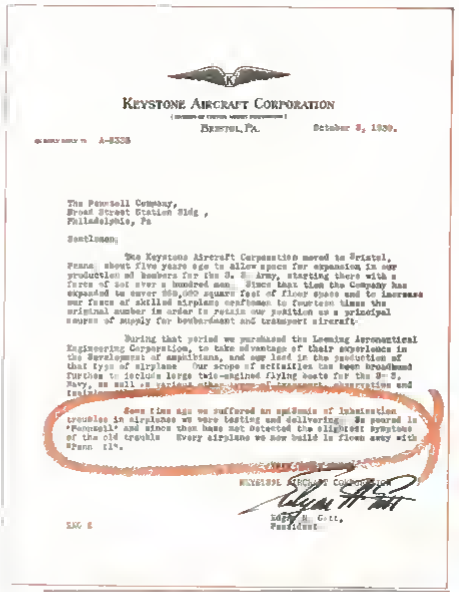
Clean, unusually efficient at high altitudes (Lees crossed Pike's Peak at 17,000 feet, climbing rapidly) the Packard-Diesel powered Waco, while not competing in the tour contest, set a new standard for safety and economy on a flight which is recognized throughout the aviation world as a major test of reliability.

PACKARD

ASK THE MAN WHO OWNS ONE



"EVERY Airplane WE NOW BUILD IS FLOWN AWAY WITH PENNZOIL"



KEYSTONE AIRCRAFT CORPORATION
BRISTOL, PA. October 8, 1930.

The Pennzoil Company,
Broad Street Station Bldg.,
Philadelphia, Pa

Gentlemen:

The Keystone Aircraft Corporation moved to Bristol, Penna. about five years ago to allow space for expansion in our production of bombers for the U. S. Army, starting there with a force of but over a hundred men. Since that time the Company has expanded to cover 300,000 square feet of floor space and to increase our force of skilled airplane craftsmen to fourteen times the original number in order to retain our position as a principal source of supply for bombardment and transport aircraft.

During that period we purchased the Loening Aeronautical Engineering Corporation, to take advantage of their experience in the development of amphibians, and now lead in the production of that type of airplane. Our scope of activities has been broadened further to include large twin-engined flying boats for the U. S. Navy, as well as various other types of commercial and military aircraft.

Some time ago we suffered an epidemic of lubrication troubles in airplanes we were testing and delivering. We poured in "Pennzoil" and since then have not detected the slightest symptoms of the old trouble. Every airplane we now build is flown away with "Penn Oil".

KEYSTONE AIRCRAFT CORPORATION
Edgar H. Gott,
President

EHG:E

"The Best Motor Oil in the World"

The letter reproduced here is voluntary testimony from one of America's foremost manufacturers of aircraft. It says, in effect: Pennzoil *is a scientifically perfect lubricant for airplane motors.* Anyone who uses Pennzoil will tell you the same thing. Pennzoil is the preferred oil of great passenger lines, and is used by good operators everywhere. Yet nothing will tell you so much about Pennzoil as a trial in your own motor. You'll know—then—the extra power and smoothness that only Pennzoil can give you. You'll discover, too, that Pennzoil lasts twice as long as ordinary oils, making it the most economical lubricant you can buy!

GUARANTEED Pennsylvania Grade by Supreme Court of Pennsylvania

PERMIT NO. 8 — PENNSYLVANIA GRADE CRUDE OIL ASS'N

THE PENNZOIL COMPANY
Executive Offices and Refinery: Oil City, Pa.
Division Offices: New York, Chicago, Los Angeles

PENNZOIL

HIGHEST QUALITY PENNSYLVANIA OIL

Air view of plant of the Keystone Aircraft Corporation, Bristol, Pa.

OVER THE MOUNTAINS WITH MAMER

THE FORD PLANE

The Ford plane is planned, constructed and operated as a commercial transport. Built of corrugated aluminum alloys, it has great structural strength and durability, and is most economical to maintain in operation. The uniformity of its material is determined by constant test. All planes have three motors in order to insure reserve power to meet and overcome emergencies. The engines may be Wright or Pratt & Whitney, totaling from 675 to 1275 horsepower. Ford planes have a cruising range of from 580 to 650 miles at speeds between 55 and 135 miles per hour. Loads carried from 3650 to 6000 pounds.

The capacity of these planes is 9 to 15 passengers and a crew of two (pilot and assistant). Planes can be equipped with a buffet-toilet, running water, electric lights, adjustable chairs.

The price of the Ford tri-motored, all-metal plane is exceptionally low —$40 000 to $50 000 at Dearborn.

Ford branches will be glad to give you information on the Ford tri-motored all metal planes in all models.

An MAT Ford transport above the clouds

At Spokane in the sunny Inland Empire

EVERY DAY a Ford tri-motored, all-metal plane soars over Seattle and Tacoma, circling up like a homing pigeon, above mountains and clouds to an altitude of 12,000 feet; then, heading eastward across the white and green crests of the Cascades, it flies in a bee-line for Spokane, through the golden sunlight of the Inland Empire. Within an hour it rolls gently to the landing-stage.

Mamer Air Transport operates two Ford 4-AT transports over this air-line, each day winging across the mountains and over clouds smoothly and dependably.

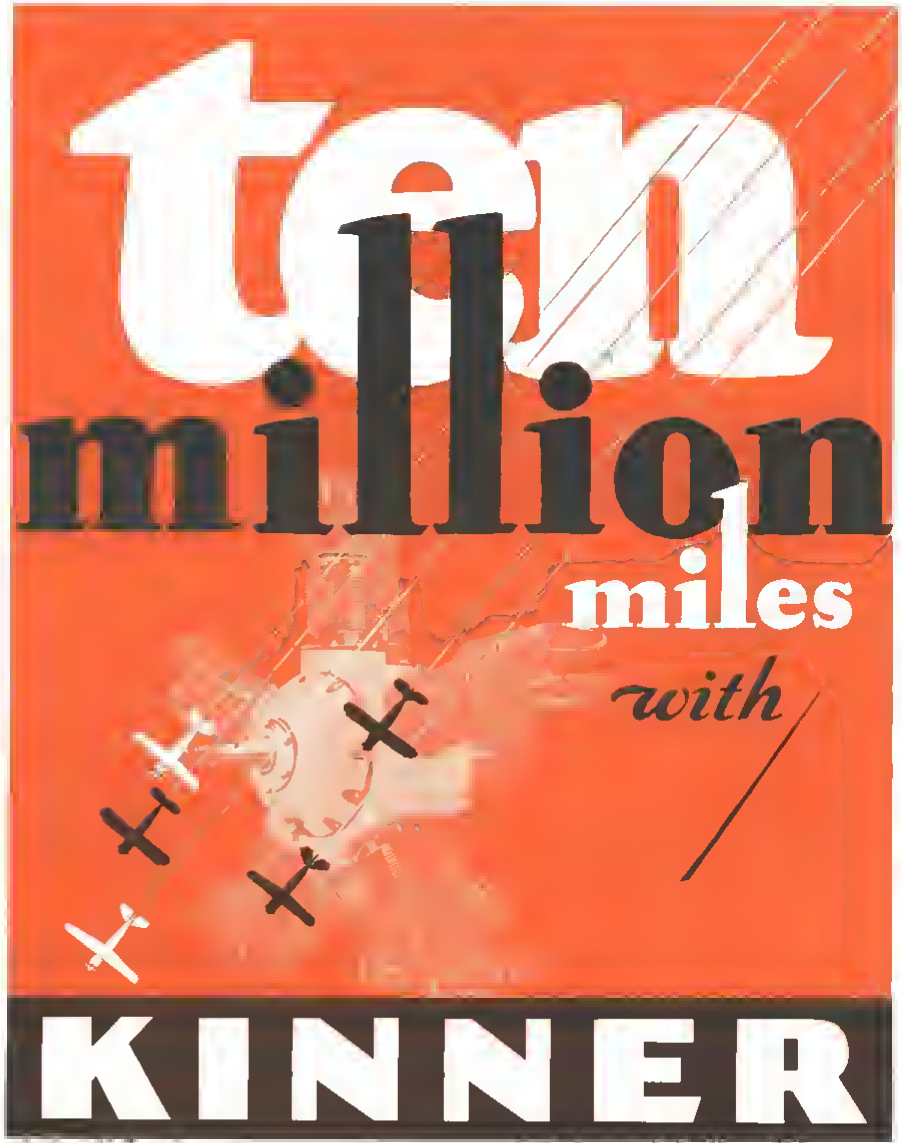
After a full year of operation the Mamer Transport Company reports:

"To date we have not had one cent of maintenance cost as a result of wear and tear."

This is one reason why both operators and the flying public use Ford tri-motored, all-metal planes for commercial, private and military use.

FORD MOTOR COMPANY

Visitors are always welcome at the Ford Airport at Detroit



An Enviable Record — For two years Kinner has completely dominated the 90 to 150 horsepower aircraft motor market. During those two years Kinner Motors have flown over ten million miles in service.

K-5 100 H.P. (A) B-5 125 H.P. (K) C-5 210 H.P

CERTIFIED PERFORMANCE

5000 miles 50 hours

Continental—7-cylinder radial engine
165 horsepower at 2000 r. p. m.

Two engines entered in the Ford Tour
Two engines operated continuously at 2100 r.p.m.
Two engines finished with perfect records
Two engines without a single part replacement
Two engines without a single adjustment

—That's Reliability

PERFECT RECORD IN FORD RELIABILITY TOUR

Throttles wide open—ships brushing the tree tops—roaring down canyons—flashing through mountain passes—lining out across hot prairies, the 1930 Ford Reliability Tour actually was a speed contest, a gruelling test of engine stamina. A magnificent tribute to the aircraft industry that no engine forced its pilot down. Each night saw overworked engines nursed back to vigor.

Continental entered the 1930 Ford Tour with two engines and finished their first reliability contest with a perfect score. Not once did either of these Continental engines falter during 5000 miles of full-throttle flying. At better than 2100 r. p. m. both completed the course *without a part replacement or adjustment.* Fifty racing hours without service other than fuel, oil and grease. Continental has again set a new standard of Reliability.

CONTINENTAL AIRCRAFT ENGINE CO.
General Offices and Factory: Detroit, Michigan

Confidence in Continental

without Replacements without Adjustments

My dear Mr Insley:

A Continental engine was installed in a Rearwin Kee-Bee 3-place open biplane which I flew in the Ford Reliability Tour.

This Continental A-70 engine went the entire route without a single part replacement or any adjustment whatsoever. In other words, your engine operated at between 2100 and 2200 r.p.m. wide open during approximately fifty hours of flying time without any service other than gasoline, oil and grease.

Very truly yours,

J. B. Rearwin

REARWIN AIRPLANES INC.
JBR:MF

My dear Mr Insley:

This trip convinced me that the A-70 is the best engine in its power class.

Not only did the A-70 give full power at all times, but during the 5,000 mile tour we flew wide open at engine speeds between 2100 and 2200 r. p. m. We did not make a single replacement of any part nor make any adjustments whatsoever beyond giving it oil, gasoline and grease.

Very truly yours

Perry P. Rush

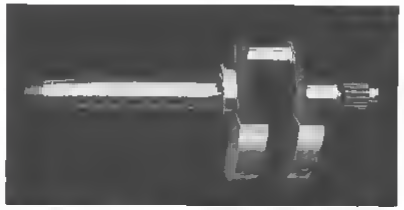
Chief Test Pilot
AMERICAN EAGLE AIRCRAFT CORP.
LBR:MF

for the Airways of America

THE new Kinner B-5, 125 H.P. Aviation Motor—like the 100 H.P. K-5 which will continue to be built—is equipped with a NORMA-HOFFMANN Precision Ball Bearing to carry the propeller thrust.

The Kinner Airplane and Motor Corporation (Los Angeles, Calif.)—after its experience with PRECISION Bearings in hundreds of its earlier models operated for long periods in all kinds of flying service—endorses their performance and manifests its confidence in them by adopting them for its latest, more powerful model.

Wherever failure would be costly—wherever safety is essential—NORMA-HOFFMANN Bearings provide that extra factor of safety which is recommended by good business as well as by good engineering. Write for the Catalogs. Let our engineers work with yours.



"NORMA-HOFFMANN"
PRECISION BEARINGS

NORMA-HOFFMANN BEARINGS CORPORATION STAMFORD, CONN., U.S.A.

ONE THOUSAND SPECIALISTS *at your command . . . .*

to serve better the electrical needs of America

HEADQUARTER specialists and field experts are at your service, when you buy your electrical supplies from the General Electric Supply Corporation.

You may need an illuminating engineer to design an installation of more productive lighting. You may desire the services of an expert as you motorize another part of your plant. You may want suggestions from a specialist when an unusual transformer job seems complex to your regular staff. You may require the services of an engineer to help you lay out your plans for more efficient handling of materials.

The General Electric Supply Corporation, with wholesale warehouses strategically located at more than 80 points throughout the United States, make all of these specialized services quickly available to you. Important to you, also, is the assurance that you can *depend* on prompt delivery of General Electric equipment from the house nearest you. When you have a perplexing problem or an electrical need . . . *write!*

Join us in the General Electric program, broadcast every Saturday evening over a nation-wide N. B. C. network

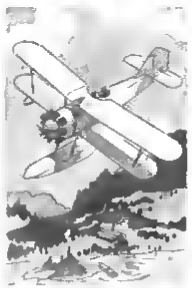
GENERAL ELECTRIC
SUPPLY CORPORATION
GENERAL OFFICES . . . . . BRIDGEPORT, CONNECTICUT

"CORSAIRS" built here will see the World

In the new Chance Vought plant at East Hartford "Corsairs" are moving down the long assembly lines on their certain way to adventure with the United States Navy and Marine Corps. Sturdy ships, ready for every sort of flying service.

Out to sea with carriers or cruisers—taking off from deck or catapult. To Mexico, China or South America. Into rough, mountainous country; into low, hot plains.

Speeding business calls, taking private owners on hunting and fishing trips. Adventure bound, these ships are built to stay with the men who will fly them. The rugged stamina that marks the standard observation plane of the Navy makes the "Corsair" an ideal ship for sport and business use. For speed, all around performance, easy handling and dependable ruggedness, the "Corsair" is at your service. CHANCE VOUGHT CORPORATION, East Hartford, Connecticut. Division of United Aircraft & Transport Corporation.



CHANCE VOUGHT CORPORATION

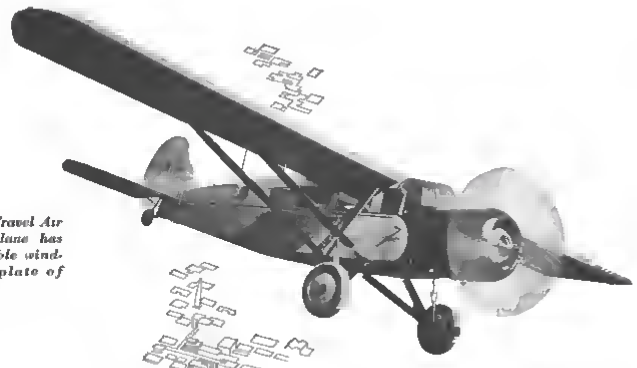
The One Metal That Flies Best—

increases revenue—decreases maintenance

- ⅓ the weight of other structural metals.
- 10 times the strength of wood. Tensile strength as high as 55,000 lbs. per sq. in. minimum guaranteed.
- Non-combustible — shatter and splinter-proof.

ALCOA

ALCOA ALUMINUM



This 6-place Travel Air Cabin Monoplane has non-shatterable windshields—Duplate of course.

DUPLATE—*Fine plate glass Laminated thickness ¼ in. Weight per sq. ft. 4.8 oz.*

DUO-LITE—*Flat-drawn sheet glass. Laminated thickness ⅛ in. Weight per sq. ft. 4.5 oz.*

AEROLITE—*Thinnest laminated glass made. Thickness ⅛ to 3/16 in. Weight per sq. ft. 2.4 to 3.6 oz.*

Now Aviation, *too*, has "*gone*" Duplate . . . . . .

THE priceless assurance of greater safety brought to motordom by the laminated glasses of the Duplate Corporation, is readily available in the field of aviation. The Duplate Corporation offers three types of non-shatter glass—Duplate, Duo-lite and Aerolite—all laminated by the exclusive Creighton process which insures permanent lamination with better visibility. Available in a wide range of thicknesses and weights to meet your every requirement, these non-shatter glasses may be procured promptly through warehouses of the Pittsburgh Plate Glass Company, located in leading cities. Write for complete information about these safer glasses for aviation, including special *bent* laminated glass. Duplate Corporation, Grant Building, Pittsburgh, Pa.

Duplate
CORPORATION
GRANT BUILDING, PITTSBURGH, PA.

AGAIN WRIGHT SETS THE PACE OF FLYING PROGRESS!

AGAIN this year, as in every year since the first flights, Aviation's progress was led and paced by pilots who chose Wright engines to do the deeds that none had done before

A year ago Byrd and his men flew to the South Pole . . . over it . . . around it and back. 1600 miles over stark Antarctica behind a "Cyclone" and two "Whirlwind" engines!

With the same "Whirlwinds" that drove him across the Pacific and thence to England, Kingsford-Smith later conquered the Atlantic westward And these Wright engines had flown over 800 hours before he hopped off from Ireland.

The Hunter Brothers flew non-stop for over 3 weeks—or a distance equal to twice around the world—behind their new "Whirlwind 300."

Hawks streaked across America behind his "Whirlwind 300" flying for less than half a day. He reached 260 m.p.h. at times and averaged 215 m.p.h.' Later he leaped from Detroit to New York at over 4 miles a minute

At the Chicago Races Wright engines won $79 out of every $100 they competed for In the National Air Tour they won 6 of the 7 top places. *Such feats as these build public faith in flying, and Aviation's stride ahead is set by what Wright is doing and plans to do!*

WRIGHT
AERONAUTICAL CORPORATION
PATERSON, NEW JERSEY
A DIVISION OF CURTISS-WRIGHT CORPORATION

THERE are two healthy reasons why Quaker State Aero Oil stands up longer and gives smoother, sweeter lubrication than any other oil produced.

Reason 1 There's an *extra* quart in every gallon of Quaker State—a full quart more of heat fighting, friction-soothing lubrication than you get in any gallon of ordinary oil.

For ordinary refining leaves in every gallon of oil one quart or more of material that is of little or no value in the lubrication of an airplane motor One quart that, as far as lubrication goes, is waste

But Quaker State Aero Oil is not refined in the ordinary way. It is *super*-refined, carried a step further by an exclusive process that removes the quart of waste. In its place you get a quart of the finest lubricant—four full quarts of lubricant to every gallon of Quaker State. So you really get an *extra* quart

Reason 2 Every gallon of Quaker State Aero Oil is made from 100% pure Pennsylvania Grade Crude Oil—the finest "base" an aero oil can have.

Try Quaker State Aero Oil. Give it hours in the air that would reduce ordinary oil to uselessness Then look at it. You'll find that it's still good lubrication —lubrication that will keep a motor purring in contentment, working its smoothest. You'll know that you've found in Quaker State the finest airplane lubricant the industry knows

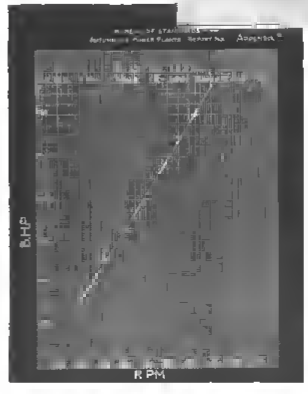
Other Pure Pennsylvania Products are

QUAKER STATE MEDIUM MOTOR OIL
QUAKER STATE MEDIUM HEAVY MOTOR OIL
QUAKER STATE HEAVY MOTOR OIL
QUAKER STATE COLD TEST
QUAKER STATE TRACTOR OILS

QUAKER STATE OIL REFINING CO., OIL CITY, PA

QUAKER STATE
TRADE MARK REG. U. S. PAT. OFF.
AERO OIL
Get that extra quart in every gallon

SMOOTHER POWER



in the JACOBS MOTOR

The Jacobs 140 is a Quality Engine—designed and built for smoother power—dependable service and longer life. Pilots have acclaimed it the smoothest motor they have ever flown. Motors in service have flown 800 hours with not a replacement. Made of the finest heat-treated alloy steel and aluminum, each part is precision tested for minute accuracy. Simple in design, all adjustable parts are visible and accessible for instant adjustment. 140 to 160 of the most responsive and reliable horsepower you have ever throttled. Standard on the Waco 140.

2 Cyl. Jacobs "Midget" 20-25 H.P.
3 Cyl. Jacobs "50" 50-60 H.P.
7 Cyl. Jacobs "140" 140-160 H.P.

JACOBS AIRCRAFT ENGINE CO.
CENTRAL AIRPORT
CAMDEN, NEW JERSEY

Even a Small Port with Limited Funds Can Have Tarmac Runways

MANY a port operator might take a lesson from the way in which a surfaced runway was obtained at the 42-acre Rodgers Field, near Pittsburgh (U. S. Army intermediate airdrome for the training of reserve pilots.) The authorities were determined to have treated surfaces on the field, to keep it in operation through the year, in all weather.

Limited funds were not allowed to stand in the way. Cinders obtained from a nearby power station were used as the aggregate. Tarmac was applied and the surface compacted by rolling. Costs were low; work was speedy. Today the field has a dustless, mudless runway and taxi strip. Skidproof, resilient on landing, and in service no matter what the weather.

Although cinders were used in this case, Tarmac will work as well with the local aggregates which are most economical in your district . . . gravel, stone or slag.

We will be glad to give you detailed information on the costs and methods of treatment in airport paving. Write.

AMERICAN TAR PRODUCTS COMPANY
Division of The Koppers Co.
General Offices: PITTSBURGH, PA.
New England Division: Tar Products Corp., Providence, R. I.

Aerial view of Rodgers Field, near Pittsburgh, showing 2150 feet of Tarmac-surfaced runway, and the taxi strip.

Close-up of Tarmac on the taxi strip. Note the granular skidproof surface.

Photos, courtesy Morris Flying Service

Surface

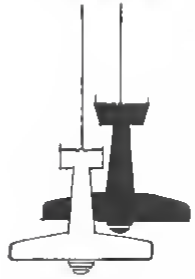
RUNWAYS
PARKING AREAS
HANGAR-APRONS
CONNECTING ROADS
TAXI-STRIPS

at moderate cost with **Tarmac**

A lighter, stronger safety glass

The Mono Airplane Co. uses Armor-Lite exclusively. This selection was due to the fact that Armor-Lite "Featherweight" is a lighter, stronger glass particularly suited for aircrafts and is easier to cut and install.

The Monocoach shown here recently completed a tour of the United States advertising the Elk's Convension at Los Angeles.



At every large airport, you will find the more modern planes equipped with Armor-Lite scatter-proof glass.

Armor-Lite is an improved safety glass that provides increased protection and visibility with decreased weight.

5 Ply Armor-Lite weighs five to ten ounces per square foot less than 3 ply sheet drawn or polished plate . . . Featherweight Armor-Lite weighs only twenty-four ounces to the square foot.

The installation of Armor-Lite increases the sales appeal of aircrafts and gives transport companies and flying schools an added advertising feature.

No safety glass made excels Armor-Lite in quality, visibility or strength . . . Write for our booklet . . . Address

AMERICAN WINDOW GLASS CO.

WORLD'S LARGEST PRODUCER OF WINDOW GLASS
PITTSBURGH, PENNA.

100% Pure PENNSYLVANIA MOTOR OIL!

RICHLUBE is approved by every major aircraft engine manufacturer in the United States

WE repeat—RICHLUBE is 100% Pure PENNSYLVANIA! Do not confuse it with "western" oils or "eastern" oils—it is a pure, unblended product—produced and refined in Pennsylvania from the finest Pennsylvania crude.

RICHLUBE Aviation Oil is the great running mate of Richfield Gasoline—every bit as good an oil as this record-breaking gasoline that is known to flyers everywhere.

To insure the very highest quality and uniformity possible, Richfield operates its own refinery in the heart of the Pennsylvania crude district where it can watch and test the quality in process to make sure that every drop is fine enough to to carry the RICHLUBE label.

RICHLUBE has proved its quality in many of the year's outstanding aviation achievements. It is used in daily service by leading air transport lines of the country!

Try RICHLUBE in your crankcase—it is guaranteed 100% Pure PENNSYLVANIA—there's none finer at any price!

Available at important airports both East and West of the Mississippi river.

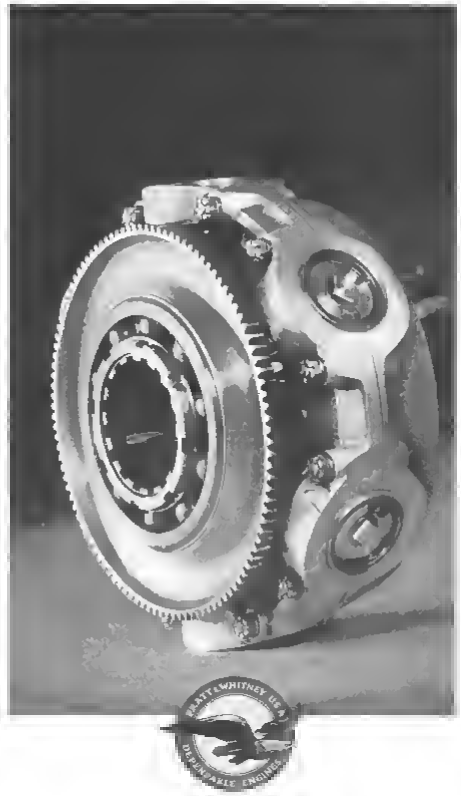
RICHFIELD OIL COMPANY - LOS ANGELES - NEW YORK CITY

RICHLUBE

100% PURE PENNSYLVANIA MOTOR OIL

REDUCTION GEAR DRIVE

FOR SLOWER PROPELLER SPEEDS



IN THE interest of increased aircraft operating efficiency it is often desirable to use geared engines. This for several reasons. The employment of a reduction gear secures better propeller efficiency by reducing the speed of the propeller. Further, on air transport ships the practise adds to passenger comfort by reducing propeller noise.

Pratt & Whitney Reduction Gears reduce propeller speeds to one-half the crankshaft speed. The gearing is enclosed in the nose of the engine. It is assembled as a unit, which permits its removal from the engine without disturbing its adjustment.

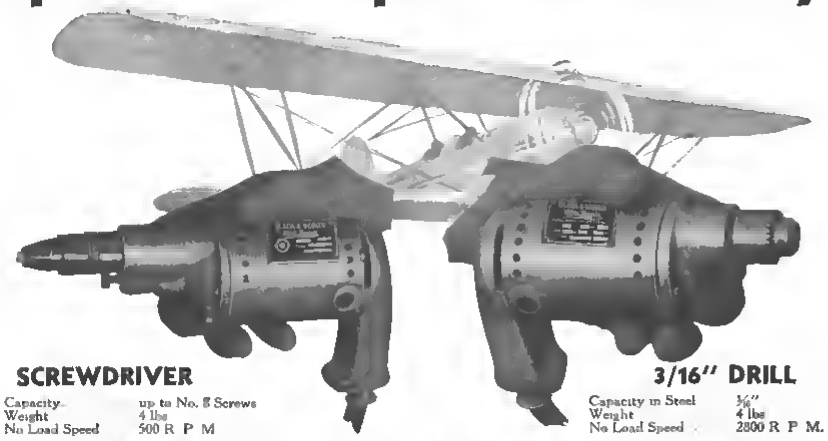
The Pratt & Whitney Aircraft Co. are pioneers in this country in the use of reduction gears for radial air-cooled engines—both military and commercial. Based on this pioneer work more and more geared Pratt & Whitney engines are being used.

Wasp & Hornet *Engines*

THE PRATT & WHITNEY AIRCRAFT CO.
EAST HARTFORD . . . CONNECTICUT
Division of United Aircraft & Transport Corporation

Manufactured in Canada by Canadian Pratt & Whitney Aircraft Co., Ltd. Longueuil, Quebec; in Continental Europe by Bavarian Motor Works, Munich, in Japan by Nakajima Aircraft Works, Tokyo

The New High Cycle Twins for Speed in Airplane Assembly



SCREWDRIVER

Capacity	up to No. 8 Screws
Weight	4 lbs
No Load Speed	500 R P M

3/16" DRILL

Capacity in Steel	3/16"
Weight	4 lbs
No Load Speed	2800 R P M.

SMALL in size, light in weight, powerful in operation the new Black & Decker-Van Dorn High Cycle Twins are designed to do their work with great ease and speed, even in close quarters. Small body diameters and rounded exterior surfaces fit the tools to the hand and afford the operator easy grasp in any position. With them your operators can do more work, in less time, at less cost.

The High Cycle Screwdriver has an adjustable friction clutch which drives the screw "flush" and releases immediately without danger of marring the screwhead or surrounding surface. Driving tension can be conveniently set with the knurled thumb screw on the gear case. When necessary, the bit can be given an extra turn by a mere pressure of the finger on the clutch control. In addition, this screwdriver has a positive clutch which allows the spindle to remain idle for finding slot in screw, and immediately engages the bit when pressure is exerted. This new unit is ideal for the many light screwdriving applications in airplane assembly work.

The drill is fitted with a 3/16" key operated chuck with key, and a 4 conductor cable without plug. Like its companion, the screwdriver, it has all the features found in the other tools of the High Cycle line including the new squirrel-cage type motor, with welded copper bar rotor, operating on 180 cycle current. This drill is particularly applicable to the requirements of the aeronautical industry.

If you are using ten or more Portable Electric Tools let one of our sales engineers show you how readily an installation of High Cycle Tools may be made in your plant, and why they will produce more work in a given time than universal motored tools. Or mail the coupon below for our catalog describing the complete Black & Decker Van Dorn High Cycle line

BLACK & DECKER-VAN DORN
SUPER PRODUCTION TOOLS

The Black & Decker Mfg. Co.
The Van Dorn Electric Tool Co.
TOWSON, MO. U. S. A.

Slough, Bucks., England — Toronto, Ontario, Canada
Sydney, Australia

BLACK & DECKER - VAN DORN
Towson, Maryland

Please send me your newly published catalogue describing the complete line of Black & Decker-Van Dorn High Cycle Tools.

Firm

Name

Address

Again BELLANCA WINS
among the single and twin engine
CABIN PLANES
in the National Air Tour

REPEATING its performance of last year the Bellanca Pacemaker again confirmed its reputation by defeating all cabin planes except two trimotors, in the National Air Tour. The 4,900-mile course led through varied flying conditions, over the plains of Western Canada, the rugged American Northwest, sections of the Rocky Mountains, and the great Middle West. This cross-country speed and efficiency contest was well calculated to determine which make of airplane is superior to the others of its class or type!

In reporting the results of this year's Tour, an aeronautical critic of The New York Times stated: "Several surprises were evident from the final scores according to the officials who designed the formula. Chief among them was George Haldeman in the Bellanca, who led all the cabin planes to the tape with the exception of the two Ford entries." (The winning Fords, of course, were trimotors, with only two of their engines counted against them in the efficiency formula.) "Haldeman, carrying a load in excess of the empty weight of his ship, performed a remarkable feat in averaging 139.1 miles an hour." The second Bellanca was close behind him.

To carry a useful load of 2,310 lbs. in an airplane which, empty, weighs only 2,290 lbs., powered with a 300 h.p. engine, at an average speed of 139.1 miles an hour over the 4,900-mile course of the National Air Tour—to land on and take off with such a load from airports of all sizes at all elevations up to 6,150 ft.—to attain at times an altitude of 1,500 ft. in clearing mountains and riding favorable winds—is an accomplishment that speaks for itself. Reduce these facts to terms of an airplane's earning capacity in business, and you have the reason for Bellanca success among all classes of owners.

BELLANCA AIRCRAFT CORPORATION
New Castle, Delaware
New York Office: Chrysler Building
Canadian Distributors: Bellanca Aircraft of Canada, Ltd., Montreal

The Bellanca Pacemaker is a six-place cabin monoplane powered with 300 hp. engine (Wright or Pratt & Whitney). Finished in finest automobile coachwork. Max. speed 142 m.p.h. Payload with pilot 2,230 lbs. U. S. Dept. of Commerce Approved Type Certificate No. 120 and No. 358. *The Bellanca Skyrocket* of similar specification is powered with the 420 hp. Wasp engine. High speed 152 m.p.h. U. S. Dept. of Commerce Approved Type Certificate No. 312. Both types are readily convertible into excellent seaplanes. *The Bellanca Airbus* is a 12 to 14 place single engined monoplane powered with either the Consuming Cyclone or Hornet. High speed 147 m.p.h. Payload 2,950 lbs. U. S. Dept. of Commerce Approved Type Certificate No. 380.

BELLANCA

Bakelite Molded contact blocks. Made by Dayton Insulating Molding Co., Dayton Ohio.

BAKELITE MOLDED AGAIN PROVES SUPERIOR FOR AIRPLANE WORK

When another form of insulation was used for contact blocks, difficulty was experienced in securing accurately positioned holes, and six or more operations were required to complete each block. Through changing to Bakelite Molded a superior block is obtained at a considerable saving in cost. Each Bakelite Molded block is completed in a single operation, with all of the countersunk screw and terminal post holes accurately formed and positioned. The block comes from the mold with a hard, lustrous surface that resists severe usage. Bakelite Molded possesses excellent insulating properties, and is very strong. It is non-hygroscopic, and will neither shrink nor swell under exposure to varying atmospheric conditions. These facts make this material exceptionally suitable for insulating the electrical equipment of aircraft. Manufacturers are invited to enlist the cooperation of Bakelite Engineering Service. Write for Booklet 59M, "Bakelite Molded".

BAKELITE CORPORATION, 247 Park Avenue, New York. CHICAGO OFFICE, 635 West 22nd Street
BAKELITE CORPORATION OF CANADA, LIMITED, 163 Duffenn Street, Toronto, Ontario

BAKELITE

THE MATERIAL OF A THOUSAND USES

EIGHT MILES

Lt. APOLLO SOUCEK, U.S.N.

HIGH IN THE SKY

READY FOR THE FLIGHT

LIEUTENANT Apollo Soucek, U. S. Navy Aviator established world's new altitude record of 43,166 feet on June 4th, 1930 with Wright Apache plane powered with Pratt & Whitney "Wasp" Engine . . . lubricated with

GULFPRIDE OIL 120

Lt. Soucek reports . . . "As far as the engine in the Apache is concerned, it worked perfectly on this record flight . . . *A High Grade Gulf Oil Called GULFPRIDE* was used for lubrication."

Lubricate your aircraft, motor car or motor boat with

GULFPRIDE OIL

America's Finest Lubricating Oil for Automobile, Motor Boat and Aircraft Engines.

GULF REFINING COMPANY

Dependable Exides aid *Accurate Avigation*

RADIO and lights. Two vital factors in accurate avigation that *must* have a dependable source of electric power. And the Exide Battery is built especially to supply ample current steadily, economically, reliably.

Light in weight, designed so that the electrolyte will not spill, Exide Batteries have proven their worth to pilots in millions of miles of flying . . under all conditions encountered by any type of aircraft.

Write for information on the many types of Exide Aircraft Batteries and their varied applications. No obligation.

Exide AIRCRAFT BATTERIES

LANDING LIGHTS can always be depended upon when Exides are on the job.

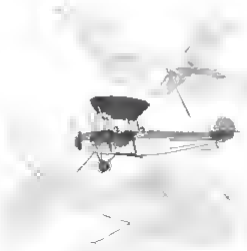
EXIDE AIRCRAFT BATTERY *is specially constructed to meet aircraft requirements.*

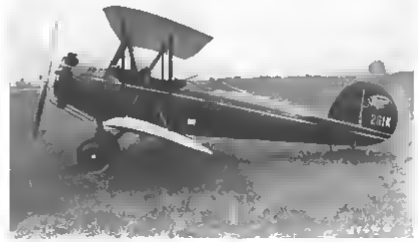
THE ELECTRIC STORAGE BATTERY COMPANY, Philadelphia

THE WORLD'S LARGEST MANUFACTURERS OF STORAGE BATTERIES FOR EVERY PURPOSE

Exide Batteries of Canada, Limited, Toronto

Eye Inspection...





FAIRCHILD KR-34 A.T.C. 162 THREE PLACE

Powered with Wright J-6, 165 H.P. engine. Bendix Brake, Fairchild Oleo landing gear, dual controls and adjustable pitch metal propeller are all standard equipment. Other items of standard equipment: air speed indicator, compass, altimeter, gasoline gauge, tachometer, booster magneto, oil pressure and temperature gauges, engine cover, cockpit covers, log book, tools, first aid kit, fire extinguisher, engine instruction books, and wiring for navigation lights. Low pressure tire equipment available at slight extra cost.

FAIRCHILD KR-21 SPORTSTER A.T.C. 215 TWO PLACE

Powered with Kinner 108 H.P. engine. Complete equipment includes: air-speed indicator, compass, altimeter, tachometer, oil pressure and temperature gauges, gasoline gauge, booster magneto, engine cover, cockpit cover, tools, fire extinguisher, first aid kit, engine instruction book and log book. Oleo landing gear, dual control, and full cockpit upholstery are standard equipment. Brake equipment and low pressure tires available at slight extra cost.

FAIRCHILD KR-21 TRAINER

For training, the KR-21 can be secured without upholstery, air-speed indicator, compass, cockpit covers, propeller spinner and a few other items of equipment.

Routine inspection such as every airplane is given is unusually easy for owners and operators of Fairchild KR Biplanes. All bearings are quickly accessible through windows, and Zerk fittings are used wherever possible to make lubrication speedy and certain. Bearing areas are generous. Other parts customarily inspected are likewise quickly seen through windows. Gas and oil tanks are speedily filled, the oil filler cap being reached through a door in the engine cowling. This cowling is in four parts, any one of which can be removed in a few minutes without disturbing the others.

Such facilitation of inspection, service and maintenance work has two important results. First, it reduces maintenance time and expense. Second, by making inspection as easy as possible it has a psychological effect, promoting regularity and thoroughness on the part of those responsible for this work. There is no excuse for letting anything go unseen. "The eyes have it." It is a joy to go over these ships.

So well are they constructed, using such strong but light materials, that replacements are reduced to a minimum. The ships stand the gaff of hard landings, of day in and day out training, sport and taxi work. Day after day the eyes of the pilot and mechanics see that all is well. Gas, oil, grease—these are the principal items of Fairchild maintenance between the fixed periods of engine overhaul. To the busy commercial operator Fairchild offers less time in the shop, more time in the air, in other words, superior economy and reliability. Write for complete details of these two remarkable Fairchild KR Biplanes.

FAIRCHILD AIRPLANE MFG. CORP.

Plants—Farmingdale, L. I., N. Y.; Hagerstown, Md., Longueuil, P. Q., Canada

Export Offices 122 East 42nd Street, New York City
Division of The Aviation Corporation

FAIRCHILD
AIRPLANES

Corrugated Transite used on Parber Standardized Buildings at the Purdy Boat Works Port Washington L. I. The cut corners of the Transite sheets make roof construction permanently tight and neat looking.

YOUR HANGARS . . . *need this sure protection against fire, rot, corrosion and weather* . . . build them with TRANSITE*

ROOFS and walls of Transite over steel frame work—here is a modern hangar construction that is absolutely fireproof, low in erection cost and free of maintenance expense for all time.

Because Transite will not burn nor support combustion—because Transite buildings are immune to flying sparks or burning embers, Transite* will give your hangars and the costly equipment they shelter, permanent protection against fire. Transite construction, wherever used is a potent factor in reducing your insurance rates.

Transite is made by combining Asbestos and cement into a material which is as long-lived as granite. Any mechanic can erect Transite and make a perfect job. It can be applied right over the steel frame work—it requires no roof deck. Transite never needs painting or other protective coating. With Transite, the first cost is the last cost.

When you build with Transite your airport buildings can be enlarged or re-designed at any time with the least loss of material. Practically all the Transite can be salvaged and used again. Write for our free book—"J-M Transite"—which will show you the many ways in which this imperishable material can increase the safety and lower the upkeep cost of your airport buildings.

**Transite in flat sheets is ideally adapted to the construction of fireproof partition walls within the hangar*

JOHNS-MANVILLE AIRPORT PRODUCTS

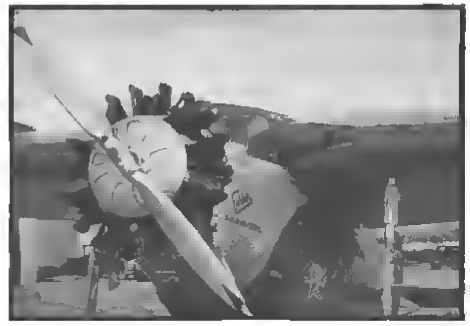
For ste eo airport buildings, Johns-Manville has developed high visibility *Built-Up Roofings* that offer long life at low cost. For taxi strips, for hangar and machine shop floors *J-M Asphalt Plank* is a long wearing, dustless self-healing floor ing. For all concrete construction such as runways sidewalks and hangar floors, *J-M Expansion Joints* assure permaneot smoothness and safety against expansion and contractioo stresses. *J-M Insulations* cover all the requirements of yeot power and heating plaots. Ask for particulars.

Johns-Manville
SERVICE TO TRANSPORTATION

The J-M trade-mark is the stamp of quality on Built-Up Roofings, Asbestos Shingles and Industrial Insulations, Packings, Flexings, etc.

Address JOHNS-MANVILLE
292 Madison Ave or 199 New Montgomery St.
New York City San Francisco
or Toronto *Canada*
Please send me a copy of your free booklet—
J-M Transite —TR-1-A TS-135-11

Name .....
Address .....
City ..... *State* .....



A COMBINATION SAFETY FEATURE NEVER BEFORE ATTAINED.....

There has been considerable discussion of the effect of Air Wheels on the use of Aerol Landing Struts. The Cleveland Pneumatic Tool Company has recommended the use of both in combination ever since the Airwheel became a provan unit.

Support of this recommendation is found in the experience of the Goodyear Tire and Rubber Company, which uses a Challanger Robin and a Fokker Super-Universal in testing and demonstrating Airwheels and Airwheel brakes.

Both of these ships are equipped with Aerol Struts and Airwheels and give about as near perfect landing as can be imagined.

The combination of the Airwheel and the Aerol Strut makes it practically impossible to make a poor landing, as the ships stay on the ground under every landing and taxiing condition conceivable.

Such a combination should be extremely favored by airplane manufacturers and users, as it provides a safety feature never before attained, together with slower landings and smoother taxiing under all conditions, and is an important factor in the maintenance and up-keep of the ship.

There is a type and size of Aerol Strut for every airplane. Aerol Struts are manufactured by The Cleveland Pneumatic Tool Company, Cleveland, Ohio.

AEROL *shock absorbing* **STRUT**

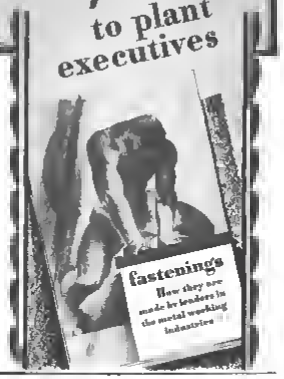
"Every Man *concerned with production* should read it"

. . . says a prominent production engineer

Any man concerned with the production of a product made wholly or partly of metal will find this new booklet, "Fastenings—How they are made by leaders in the metal working industries," most interesting reading. The chances are, too, that he will obtain from it information of considerable value to his own work.

This booklet contains accurate descriptions of the ways in which greater fastening economy has been attained on the Servel Refrigerator, Philco Radio, Hotpoint Range, Ford Tri-motor Plane, Simmons Metal Furniture, Zenith-Detroit Carburetor and other well known products. All of the facts and figures given, were secured through fastening studies made by independent engineers in the plants of fourteen of the most prominent concerns in their respective fields.

"Fastenings" will be sent free of cost or obligation to any plant executive. It is only necessary to fill in the coupon and attach it to your letterhead.



PARKER-KALON CORPORATION
Dept M, 192-200 Varick St., New York, N. Y.

Send a free copy of "Fastenings" marked to the personal attention of:

Name and Title .....

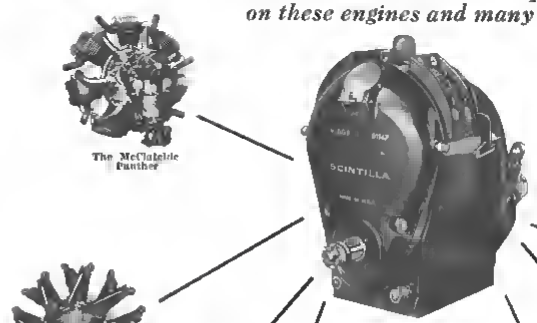
Company .....

Street and City .....

PARKER-KALON *Hardened* Self-tapping Screws

SCINTILLA
AIRCRAFT MAGNETOS

are standard IGNITION equipment on these engines and many others



The McClatchie Panther

Lambert 6 model E-260

The Wright Cyclone

The Aero Development Company's Speer S-2-C

The American Cirrus

Packard 24 cylinder engine

The Harlesame—4 cycle 150 HP Engine

Pratt & Whitney Hornet

A Kinner K-5

The "Comet"

Michigan Aero Engine Corp. "Rover"

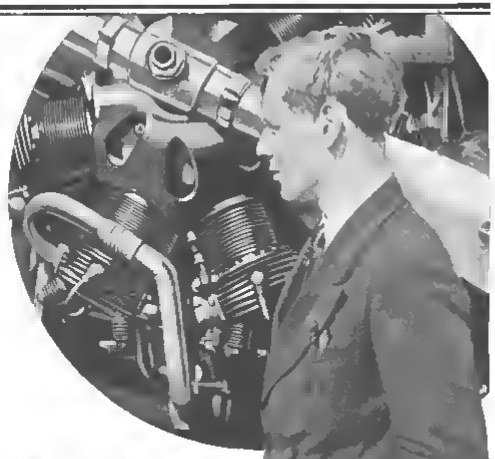
The Curtiss Conqueror

SCINTILLA MAGNETO CO., INC.
SIDNEY, N. Y.
(Contractors to the U. S. Army & Navy)
Division of Bendix Aviation Corporation

DEPENDABILITY
SIMPLICITY
ACCESSIBILITY

Again WARNER *comes thru!*

Captures first place for Great Lakes Trophy on National Reliability Tour



Adding still further to the luster of Warner Achievements, Eddie Schneider, the young 18-year-old pilot, has just romped home with the Great Lakes Trophy awarded to the pilot in the National Reliability Tour, making the highest score with an engine less than 510 cubic inches.

Using a Cessna Monoplane now over a year old, powered with Warner engine No 361, produced in August, 1929—the same plane and engine with which he broke the three Junior Transcontinental Records—Schneider entered the Reliability Tour without special preparation of any kind. No stream lining of the plane—nor an engine overhaul.

Scoring 47,488 points, he was 11% in advance of his nearest competitor, who scored but 42,742.9. At the same time Schneider carried a 40% greater load—at a greater speed—with less rated horsepower

Could any other test more conclusively demonstrate Warner Superiority?

WARNER AIRCRAFT CORPORATION
DETROIT, MICHIGAN

Scarab

WARNER "*Scarab*" ENGINES

Four Place Stinson Junior SM Powered with 215 H P Lycoming Engine.

SRB Ball Bearings are used at all Important Points in Lycoming Aircraft Engines

FOR the radial loads on the crankshaft, to sustain the propeller thrust and support the rocker arms, Lycoming have chosen SRB —because SRB with its maximum number of large balls, hot forged from molybdenum steel, gives the utmost in load carrying capacity and that dependability so necessary in aeronautical power plants. That is why SRB Ball Bearings predominate in the aircraft engine field and are found in Wright, Curtiss, Pratt and Whitney, Warner, LeBlond, Velie and other well known engines. Specify SRB, the aeronautical ball bearing for absolute dependability in your own equipment. Make sure that the ball bearing specification is worthy of the equipment you build. SRB engineers will be glad to cooperate with your engineering department.

Ball SRB Bearings

STANDARD STEEL AND BEARINGS INCORPORATED
Plainville Connecticut
DIVISION OF MARLIN-ROCKWELL CORPORATION
F M Cobbledick Co., San Francisco, Cal
Pacific Coast Distributors
Northwest Bearings Co., Seattle, Wash
E D Maltby Co., Los Angeles, Cal

THE LONGEST FORWARD STEP IN MOTOR OIL

the new

SOCONY MOTOR OIL

Perfected...proved... in every way

THIS is an announcement so important to every aviator that we put aside all technical language and tell it to you in the simplest words.

We have produced the New Socony Motor Oil which gives you—to a greater degree than any other—what you want and should have in a motor oil . . . *full lubricating value.*

In the new Socony Motor Oil "full lubricating value" means something more than it ever has meant before. For we have perfected and proved for you not just one or two but *every* characteristic a motor oil should have

Here are five reasons for changing today to the New Socony Motor Oil

1. ***Perfected Lubrication. Less wear on your motor.*** The new Socony Motor Oil is made from a Paraffin Base crude, selected because of its greater inherent oiliness (adsorption) Exclusive New Socony Process gives additional lubricating value

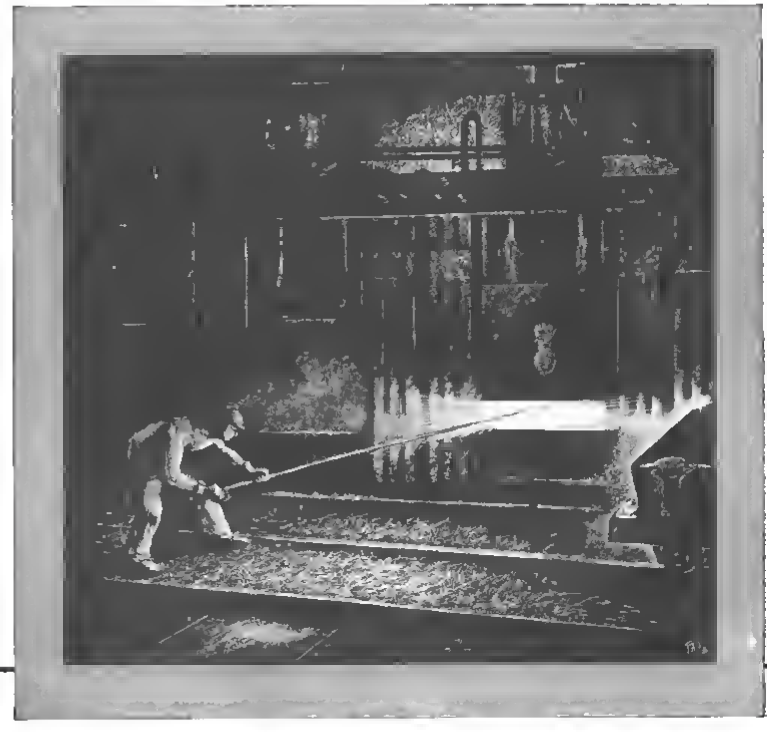
2. ***Minimum Oil Consumption. Will not break down.*** No engine heat or pressure severe enough to decompose this oil or destroy its lubricating value. Only through contamination by foreign matter which finds its way into the crankcase can the life of this oil be limited.

3. ***Easy Starting in Coldest Weather.*** Selected Paraffin Base oil completely de-waxed More fluid at low temperatures than any other oil Instant lubrication Less drain on your battery

4. ***Fuel Economy and Increased Power.*** Maintains proper "body" at all engine temperatures Result: perfect piston seal, maximum power, and minimum fuel consumption

5. ***A Clean Motor.*** New refining process reduces to a minimum all harmful elements which cause carbon, gum and sludge The new Socony Motor Oil insures a clean motor.

STANDARD OIL COMPANY OF NEW YORK



Cooking the *"broth"* this way costs more ... *but see the results!*

CAREFULLY the "cooks" tend their cauldrons of seething metal. One scans his "broth" with practiced eye... and adds more of this, or of that Another dips a sample for testing. Each bubbling potful is painstakingly watched, "seasoned", tested . . . clear through to the final pouring.

Talk to a Roebling steel man and he will tell you that this exceptionally close control of the melt is made possible through using only *small* open-hearth furnaces. That making steel this way costs more... but a consistently higher grade, unvarying product results.

It is this *old-fashioned thoroughness...* coupled with modern production methods . . that makes Roebling Aircraft Wire, Strand and Cord, what it is!

JOHN A. ROEBLING'S SONS COMPANY
WIRE . WIRE ROPE . WELDING WIRE
COPPER & INSULATED WIRES & CABLES
TRENTON, N.J. *Branches in Principal Cities*

ROEBLING WIRE AIRCRAFT PRODUCTS

ANCHOR FENCED FOR SAFETY

PRATT & WHITNEY AIRCRAFT CO.

THE GLENN L. MARTIN CO.

WRIGHT AERONAUTICAL CO.

CURTISS FLYING FIELDS

CENTRAL AIRPORT

ROOSEVELT FIELD

Public safety at airports is a major problem today. Airport operators who are awake to this problem are taking immediate steps to provide adequate protection.

For handling crowds, protecting the ships and controlling the field, Anchor Fences are the greatest aid. Anchor Fences are protecting some of the most important air terminals in the country today.

The demand for this Anchor Fence protection made possible the establishment of the Anchor Airport Sales Division. This special Airport service is available to all Airport operators throughout the country

ANCHOR POST FENCE COMPANY
Eastern Avenue and Kane Street
Baltimore, Maryland

Albany Boston Buffalo Charlotte Chicago Cleveland Detroit Hartford
Houston Los Angeles Mineola, L.I. New York Philadelphia Pittsburgh
St. Louis San Francisco Shreveport, La.

Representatives in all principal cities. Consult your local classified directory

ANCHOR FENCES

AGAIN...

WACO Demonstrates Its Matchless Performance by

the FASTEST ✓ speed
the QUICKEST ✓ take-off
the SHORTEST ✓ landing

of all aircraft entered in this year's National Air Tour

AGAIN in 1930, as in the two preceding years, the WACO entries in the National Air Tour consistently demonstrated that same matchless performance which has made WACO the most popular commercial aircraft in America.

In many respects, the WACO performance this year is, in fact, even more impressive than in the two preceding Tours. For, though WACO had to be content with second and third place under the revised scoring formula, it is significant

that the WACO entries, in the competitive tests at Detroit, showed the *quickest take off* of any ships in the Tour. John Livingston was timed by the judges in 6.83 seconds, Art Davis in 7.13 seconds, and Les Bowman in the WACO Model F in 7.73 seconds.

that the WACO entries likewise showed the *shortest landing* of any airplanes entered. The stop watches showed 5.03 seconds for both Livingstoo and Davis, and 5.55 seconds for Bowman. Measured in *distance* rather than *time*, that is less than 50 yds.

that throughout the 4828 miles of the Tour, Davis and Livingston also showed the *fastest speed* of any of the entries, their average speed for the entire distance being respectively 148.4 and 148.3 miles per hour

This combination of high speed with quick take off and short landing is remarkable, as those technically versed will appreciate . . particularly so in view of the high percentage of A.T.C. "useful load" which is 47.7% of the gross weight

Such a combination of performance characteristics is typical of WACO . . short landing and quick take-off to get into and out of otherwise impossible landing places . . . satisfying high speed to "go places and do things" . . . load-carrying capacity for practical workaday utility.

There are 18 models in the WACO line, in four price classes, from $2565 to $8525. WACO airplanes are so sturdily built that they don't require pampering . . . so amazingly easy to fly that the veriest novice can take the stick with confidence . . so thrillingly maneuverable that the ablest stunt pilot will find that they measure up to his abilities

But find out for yourself. It would be a pleasure . . for us both. ✕ ✕ ✕ The WACO Aircraft Company, Troy, Ohio

The two friendly rivals, John Livingston and Art Davis, again flew a nip and tuck race. As in 1929, Livingston nosed out Davis in the point scores by a slim margin. But Davis had the advantage of slightly better speed, averaging 148.4 miles per hour for the entire distance of nearly 5000 miles—a margin of an eyelash over Livingston's average speed of 148.3 m. p. h. More consistent performance than that is inconceivable! It reflects the consistent design and workmanship of WACO construction.

✕ ✕ ✕

The reason why WACO was *not* awarded the third and final leg on the Ford Reliability Trophy is no trade secret. The formula for scoring this year's Tour was altered in such a way that no single-engined ship could hope to place first. The winning entry was given over 40% credit in the power factor of the scoring formula for its tri-motor design. Yet it nosed out the second place WACO by only 5% in total points scored

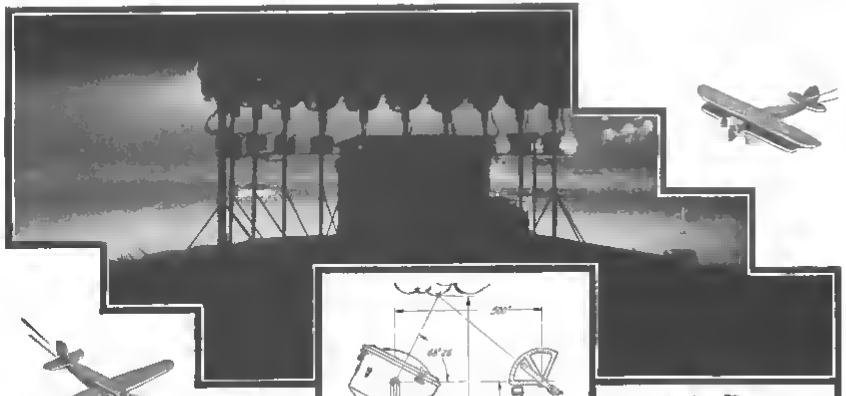
Your choice of an airplane, however, can be based strictly on *performance*.

✕ ✕ ✕

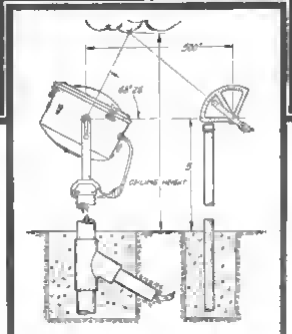
All three WACO entries placed "in the money," being among the first ten in point scores in the Tour. No other open cockpit airplanes got into this charmed circle. No other aircraft of *any* classification showed such quick take-off and short landing as the three WACO entries. Those are significant facts to anyone interested in aircraft to the point of purchase!

WACO AIRPLANES

"ASK ANY PILOT"



Right—*Ceiling projector and alidade for determining ceiling height*



DAYLIGHT LANDINGS

24 hours a day---

WHAT a lighthouse is to a seaman, airway and airport lighting is to the night flier—they guide him along his course, show him a haven out of the dark, finally helping him to a safe landing. And with Westinghouse equipment this airway lighting will be trouble-free, and this airport lighting glare-free—it will give daylight landings 24 hours a day.

Even though your field is on a main airway, fliers cannot safely land at night without light. Give them Westinghouse lighting for safe landings. Have the name of your port appear with the highest rating.

Call in an airport lighting specialist from the Westinghouse office near you, and have him plan a flexible system of lighting—a system you can progressively and economically expand in the future.

Complete Lighting Service for an "A" Airport

BEACONS
FLOODLIGHTING PROJECTORS
WIND-DIRECTION INDICATORS
CEILING PROJECTORS
ON COURSE LIGHTS
ALIDADES
FLUSH TYPE MARKER LIGHTS
DIRECTIONAL BEACONS
OBSTRUCTION LIGHTS
LANDING FIELD PROJECTORS
PANELBOARDS
UNDERGROUND CABLE
HANGAR LIGHTING EQUIPMENT
REGULATORS
TIME SWITCHES
ISOLATING TRANSFORMERS (Safety Coils)
SWITCHES
LAMPS
MOTORS

Westinghouse Lighting Specialists will help you plan an effective lighting system

Westinghouse

T 31558

TUNE IN THE WESTINGHOUSE SALUTE OVER THE N. B. C. NATION WIDE NETWORK EVERY TUESDAY EVENING

RCA

Since its formation more than ten years ago RCA has consistently maintained undisputed leadership in the field of radio communication equipment. Its assured position in this field is directly traceable to public confidence inspired by sound engineering and backed by a responsible organization. RCA especially solicits the confidence and good-will of everyone in every branch of aeronautics

RADIOMARINE CORPORATION OF AMERICA

66 Broad St. New York

433 South Spring Street, Los Angeles
512 St Peters Street, New Orleans
1599 St Clair Avenue, Cleveland

Ask the Veteran Flyer

Thousands of veteran flyers have come to accept the Zapon guarantee of absolute dependability as final. Manufacturers, after exhaustive tests, are repeatedly giving first preference to Zapon.

Clear Nitrate Aeroplane Dopes
Semi Pigmented Aeroplane Dopes
Gloss Pigmented Aeroplane Dopes

These Zapon products are made by Zapon with a full understanding of the importance of safety in the air. As a result constant laboratory tests of the most exacting nature leave absolutely nothing to chance.

Also Thinners, Lacquer Enamels and Lacquer Primers

Today a majority of the finest cabins are upholstered in Zapon Cloth because of its extreme durability in vivid coloring and charming patterns. For 47 years its superiority has continued unchallenged.

THE ZAPON COMPANY
STAMFORD, CONN.
Subsidiary of Atlas Powder Company

BOEING-TRAINED Pilots know more than just "How to Fly"

EMPLOYERS—and the flying public—are demanding pilots, men who know planes and engines intimately, men thoroughly grounded in meteorology, avigation and radio, who can fly by instruments, at night, and in bad weather. Men who know the "Why" of flying, as well as the "How."

As pilots like that are developed, aviation itself will develop. That is why the Boeing System—division of the United Aircraft & Transport Corporation—established the Boeing School of Aeronautics and spared no expense to make it the nation's best equipped flying school. Fifteen instructors . . . $100,000 worth of training planes. A Boeing diploma "means more."

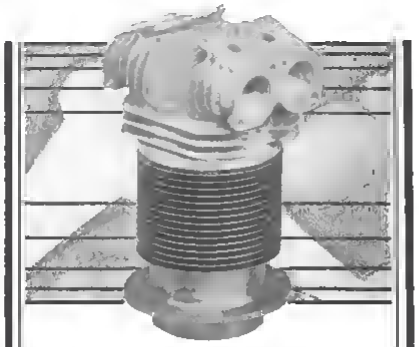
The coupon below is an opportunity to get facts about this internationally known "University of the Air." Mail it today!

New classes start January 5, 1931

BOEING
SCHOOL OF AERONAUTICS
Division of United Aircraft & Transport Corporation

BOEING SCHOOL OF AERONAUTICS AV 11-30
Airport Oakland California
Gentlemen: I am interested in
☐ Private Pilot ☐ Boeing Master Pilot
☐ Limited Commercial Pilot ☐ Boeing Master Mechanic
☐ Transport Pilot
Name
Address
City State

UNIVERSAL FACILITIES



THE Govro-Nelson shop holds an enviable reputation with leading manufacturers of aircraft engines.

The reason is logical—long experience, precise testing equipment and accurate production machines are bound to combine to produce aircraft engine parts with the most faithful exactness. Crank-cases, cylinder-heads, oil-pumps, pistons and bearing sleeves are but a part of the wide variety of parts manufactured by Govro-Nelson in both large and small quantities for the industry's leading engine builders.

You, too, will learn to expect the utmost from Govro-Nelson on any aircraft engine part.

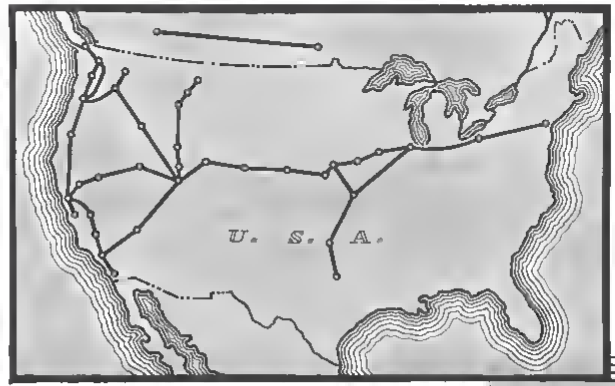
The GOVRO NELSON *Co.*

Specialists in the Machining of Aircraft Engine Parts

1931 ANTOINETTE, DETROIT, MICH.

GOVRO-NELSON

EVERY DAY ADDS 25,000 MILES to the Boeing mail-plane record!



Left—Eight American and one Canadian mail-passenger lines flying on routes shown at left use Boeing equipment.

Below—Hornet-powered Boeing 40 of Empire Oil Co.—one of a number of corporations which have purchased these dependable economical planes

NO PLANE ever built has outlived the famous Boeing "40" in continuous service. Already several "40s" have flown 3,000 hours on the transcontinental route and are still "going strong." Nineteen of the twenty-four put into service three years ago are still on the job seven days a week. The real cost of an airplane is the cost per hour of its flying life.

The price of the 40-B4 (Hornet-powered) has just been reduced to $22,500. Planes are completely equipped—no extras to buy . . . Ask for detailed performance figures.

These pioneer air lines use Boeing planes: Aviation Corporation, Barnes and Gorst, Boeing Air Transport, National Air Transport, National Parks Airways, Pacific Air Transport, Varney Air Lines, Western Air Express and Western Canada Airways.

40-B4s ARE AVAILABLE FOR IMMEDIATE DELIVERY.

BOEING
AIRPLANE COMPANY
SEATTLE, WASH.

A division of the United Aircraft and Transport Corporation

(In Canada: Boeing Aircraft of Canada Ltd., Vancouver, B. C.)

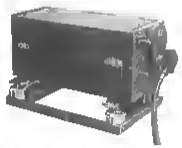
A NEW TYPE AIRCRAFT RECEIVER

THE Model D Stromberg-Carlson Aircraft Receiver adds new *safety* and dependability to flying operations. It is designed for aircraft reception of radio range signals, weather reports and all other radio aids to *safe* flying. Interchangeable Coil Sets make this instrument adaptable to the entire radio spectrum.

A particularly favorable signal-to-noise ratio, accompanied by high sensitivity and selectivity, is its outstanding electrical characteristic. Extreme simplicity of construction, together with the ease with which Model D may be controlled, appeal to both the aeronautical engineer and the radio technician.

Let us send complete details of the new Model D Stromberg-Carlson Aircraft Receiver

Stromberg-Carlson Telephone Mfg. Co., Rochester N. Y.
Address all inquiries to our Sales Representative:
Aircraft Radio Corporation, Boonton, N. J.



Model D Stromberg-Carlson Aircraft Receiver equipped with Eveready Raytheon 4-Pillar Tubes and powered by Eveready Dry Batteries. Over all dimensions of Receiver and Mounting Base: 16½ x 9¾ x 9¼ inches. Weight: 16 pounds. Licensed Under: A. T. & T. Co., R. C. A., R. F. L. and Aircraft Radio Corp. Patents.

Stromberg-Carlson

Makers of Voice Transmission and Voice Reception Apparatus For More Than Thirty-Five Years

PERRY-AUSTEN DOPES

Don't Crack
Don't Peel
Don't Rot

Good Take Up
Good Fill
Easy to Apply

These essential qualities of good dopes are demanded by experienced aircraft manufacturers. That they are inherent in PERRY-AUSTEN DOPES has been proven by Government and manufacturers' laboratory tests and in practical service on thousands of military and commercial aircraft.

PERRY-AUSTEN DOPES are produced by the oldest manufacturer of aircraft dopes in the United States and they are used by many of America's foremost aircraft manufacturers. Ask for our quotations, whether for large or small quantities.

Contractors to United States Government

PERRY-AUSTEN MFG. CO.
Main Office and Works, Grasmere, Staten Island, N. Y.
Tel. Dongan Hills 707

Chicago
310 N. Dearborn St. Tel. Superior 6948

STEEL HANGARS

THE MARION LINE

When either the small planes or the graceful transports dip down from the air lanes, it is comforting to owners and pilots if the airport is equipped with

MARION
ALL-STEEL HANGARS

They are roomy, strong, clean cut in appearance, economical and fire and weather proof.

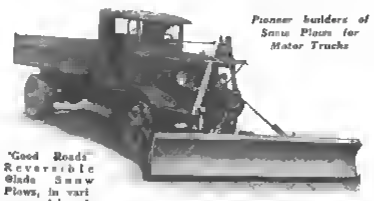
Address Department H

MARION MACHINE FOUNDRY & SUPPLY CO.
MARION, INDIANA

HIGH-SPEED SNOW REMOVAL with SNOW PLOWS

GoodRoads MACHINERY
TRADE MARK

Pioneer builders of Snow Plows for Motor Trucks



"Good Roads" Reversible Blade Snow Plows, in various models, adaptable to any standard truck from 1 ton capacity to the heaviest built.

THE GOOD ROADS MACHY. CO.
Incorporated
KENNETT SQUARE, PA.
"Snow Plow Headquarters"

NEW YORK — PHILADELPHIA — PITTSBURGH
WATERTOWN, MASS. — CHICAGO — HARRISBURG, PA.

ANNOUNCING
THE NEW BUDD

AIRPLANE RIB

An original development in spot-welded stainless steel. Non-corrosive. Low priced. Light. *Write for information.*

EDWARD G. BUDD
MANUFACTURING CO.

Philadelphia · Detroit · Pittsburgh

Rigidly Built... to Rigid Standards

EDO FLOATS

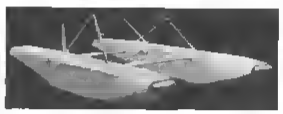
ILLUSTRATED above is one of the operations in the construction of the EDO All-metal Floats—the placing and pneumatic riveting of the bottom sheets. This is typical of the modern equipment, methods and workmanship which have made EDO Floats a standard of the aircraft industry. The cutaway section of a float illustrates its sturdy simplicity—bulkheads corrugated for rigidity—die stamped gussets of standardized design—absence of complicated and trouble-breeding internal trussing—patented fluted bottom.

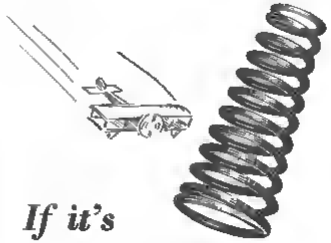
The standards of efficient design and modern construction under which EDO Floats are produced have met with such approval throughout the aviation world that most leading airplane manufacturers now entrust to EDO specialization and experience all their float problems. As a result, EDO All-metal Floats, interchangeable with wheel landing gear, are now licensed for use in the United States or Canada on over 37 distinct types of land planes—more than all other makes of floats combined.

To increase the uses of your airplanes and enlarge your opportunity for sales, a letter will place EDO at your service in float or flying boat hull design and construction. For particulars, address, EDO Aircraft Corporation, 600 Second Street, College Point, Long Island, N. Y.

NOTE THESE POINTS OF EDO FLOATS

- All metal construction
- Anodically treated against corrosion
- Will not swell, shrink or absorb water
- Water-tight bulkheads every 2 feet
- Patented fluted bottoms for quick take-off
- Heavy keels, shallow stems for beaching
- Flat decks for ease of taking on loads
- Wide sterns for perfect taxying
- Easy to install and overhaul





If it's DEPENDABILITY *you want...*

...to keep your Production Lines on the move, Barnes-made Springs have been building a reputation for dependable service for years. Won't you tell us your spring requirements... one or a million?

The Wallace Barnes Co.
BRISTOL, CONN., U. S. A.

COLONIAL GRAIN AVIATION LEATHER

Cut down aeroplane weight with this LIGHT WEIGHT LEATHER

Colonial Grain makes it possible for you to have durable, beautiful, and fireproof *leather* upholstery together with Light Weight. In fact, Colonial Grain is one of the lightest of upholstery materials, averaging only 0.098 pounds per square foot It is easy to see, therefore, why Colonial Grain Leather is the logical upholstery material and is fast gaining recognition. See the difference in aeroplane poundage it will make for you. *Send for a sample.*

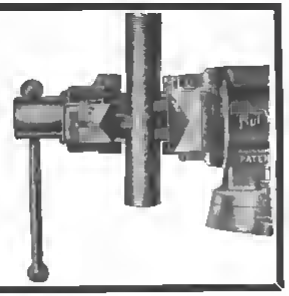
EAGLE-OTTAWA LEATHER CO.
GRAND HAVEN, MICH.

Sales Offices: NEW YORK CHICAGO ST. LOUIS SAN FRANCISCO

NuTYP VISE

Locks in any position

Working on odd shaped parts is made much easier with the NuTYP—a time and labor saver for the aircraft industry. Grips rounds or flats in any position. See your dealer or write us for complete information.



INTERNATIONAL NuTYP TOOL CORP.
OSWEGO, N. Y.

E-803

The Searchlight Section

of this issue covers the current business wants of the industries in which this paper is read.

For Every Business Want
"Think SEARCHLIGHT *First"*

A Personal Want— can invariably be filled by a friend.

A Business Want— must be satisfied by someone in your industry.

GN-920

SAVE TIME and EXPENSE in

ENGINE CLEANING

In the grooming of airplane engines, compressed air has come to play an almost indispensable part Not only does the Brunner method show big economies in time and expense over the other methods, but a neater, more thorough job is possible Such is the unanimous testimony of scores of airplane mechanics

But engine cleaning is only one of many airport chores which Brunner-Air performs Improved spraying of wing dope and finishes economical valve grinding and testing greasing, tire inflation—these services are all done better with Brunner equipment

No. 78 Engine Cleaner

The illustrations to the right show two popular engine cleaning devices Engine Cleaner No 78 may be used for blowing and dusting as well as cleaning in the manner illustrated above No 79, designed for spray lubrication, can be effectively used as an engine cleaner This cup holds one quart

No. 79 Engine Cleaner

Aircraft Division
BRUNNER MFG. CO.
UTICA, N. Y.

MODEL 554

This Brunner Compressor is ideally suited to general airport duty It is soundly constructed after the improved Brunner design and incorporates all recent refinements For complete details and specifications see page 75 of the Brunner Manual

GET THIS BOOK
The Brunner Air Compressor Manual contains complete information on the complete installation of compressed air for the aircraft industry. Write for your copy today.

BRUNNER
AIR COMPRESSORS
A WORLD'S STANDARD OF DEPENDABILITY

MOVE THE BENCH NOT THE JOB

Pat'd and Pats Pending

"Hallowell" Semi-Portable Bench of Steel

A Semi-Portable Work-Bench on two casters—one you can trundle around from place to place; from job to job—how does that strike you?

Before the "HALLOWELL" Semi-Portable of Steel a work-bench was a fixture—once in position, there it remained.

Not so with the "HALLOWELL"—grab the handles and trundle Bench and all to where you want it; let go, and the "HALLOWELL" lands on its two plain feet and becomes, at once, rigid as a rock.

And when the job is finished, roll the "HALLOWELL" away and leave it where least in the road, so floor and wall spaces can be used to best advantage. Otherwise the construction is just like the now famous line of

"HALLOWELL" STEEL BENCHING

Prices and Complete Data in Bulletins 386 and 416

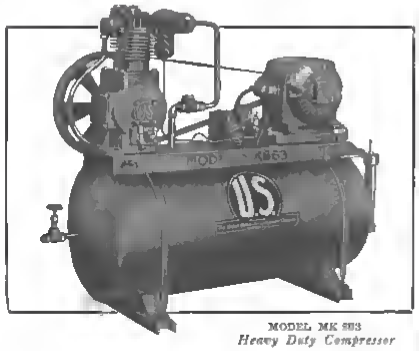
WE MANUFACTURE:

"HALLOWELL" STEEL WORK-BENCHES
"HALLOWELL" STEEL WORK-TABLES
"HALLOWELL" STEEL WORK-BENCHES, SEMI-PORTABLE
"HALLOWELL" STEEL-WOOD WORK-BENCHES
"HALLOWELL" STEEL-WOOD WORK-TABLES
"HALLOWELL" STEEL BENCH-DRAWERS
"HALLOWELL" STEEL CHAIRS AND STOOLS
"HALLOWELL" STEEL SHOP-FURNITURE
"HALLOWELL" STELL FLOOR TRUCKS
"HALLOWELL" STEEL LIFT-TRUCK PLATFORMS
"UNBRAKO" HOLLOW SET SCREWS
"UNBRAKO" SOCKET HEAD CAP SCREWS
"UNBRAKO" STRIPPER BOLTS
"UNBRAKO" PIPE PLUGS
POWER TRANSMISSION APPLIANCES

Take Your Pick Please—Then Write Us

STANDARD PRESSED STEEL CO.
JENKINTOWN PENNA
BOX 528

BRANCHES: BOSTON CHICAGO DETROIT
BRANCHES: NEW YORK SAN FRANCISCO ST LOUIS



MODEL MK 883
Heavy Duty Compressor

Look to the Unit "BEHIND THE GUNS"

BACK of the paint spray guns, grease guns, and blow cleaning guns so much in evidence about the modern hangar, is a dependable source of compressed air—supplied in hundreds of hangars by U. S. Air Compressors

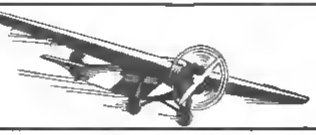
Look at the compressed air unit in any hangar. If it bears the familiar "U. S." trademark you may be sure the supply of compressed air in that hangar will never be threatened. U. S. Air Compressors have enjoyed a reputation for ABSOLUTE DEPENDABILITY that dates back to the pioneering days of the aviation and automotive industries.

Write for Bulletin No. 26 giving complete information on U. S. Air Compressors, Grease Guns, Paint Spray Units, and other equipment in the U. S. Hangar Equipment line.

The U. S. Air Compressor Co.
5348 Harvard Ave., Cleveland, Ohio

U. S. HANGAR EQUIPMENT

THE U. S. AIR COMPRESSOR CO.
5348 Harvard Ave.—Cleveland, Ohio
Please send me Bulletin No. 27 on U. S. Hangar Equipment.
Name
Airport
City



Our wide experience in the field of AUTOMOTIVE ENGINES makes us a most practical source for

AIRPLANE SPRINGS

on a production or experimental basis

"Two Plants for Spring Service"
DETROIT DIVISION 6400 MILLER AVENUE — BGR INC. — COOK SPRING DIV'N ANN ARBOR, MICH.

BARNES-GIBSON-RAYMOND-ING

"Fortify for Fire Fighting"

Soda and Acid Type for free-burning fires in rubbish and textiles where cooling and quenching counts.

Pyrene
FIRE EQUIPMENT FOR EVERY HAZARD

Pyrene Manufacturing Company
NEWARK NEW JERSEY
ATLANTA KANSAS CITY CHICAGO SAN FRANCISCO

Enforce Safety at Your Airport with Cyclone Fence

The 5th Annual Air Tour last year proved that fencing is absolutely essential to the handling of crowds at airports. Many troubles were experienced at open airports. A magazine editor reporting the tour said "Crowds invaded the fields as soon as planes had landed. They milled heedlessly about while engines were being warmed up and the absence of fatalities can be accredited only to providential intervention."

But where airports are fenced, crowds are always out of danger, adding to the safety of both fliers and spectators.

Many leading airports have already installed Cyclone Fence. It is an invitation to air tours to visit their cities. It helps them become terminals for air lines. Interest in aviation is stimulated by absence of casualties.

Cyclone Fence is made of durable copper-steel and lasts for years in any climate. Special wide gates for airports. Erected on H-Column line posts for maximum strength. Installed by our own trained crews. Service everywhere.

Write for information
No obligation

CYCLONE FENCE COMPANY
Subsidiary of
UNITED STATES STEEL CORPORATION
General Offices: WAUKEGAN, ILL.
Branch Offices in All Principal Cities
Pacific Coast Division: Standard Fence Co., Oakland, Calif.

Cyclone Fence
REG. U.S. PAT. OFF.

VERSATILE FELT

The American Felt Company, largest Felt manufacturers in the world, would welcome an opportunity to cooperate with your engineers. Daily, hundreds of difficult engineering and manufacturing problems are being solved by the intelligent use of Felt.

We are equipped to supply Felt in bulk or cut to the most exacting specifications. And once your order is placed, your worries cease—for your production schedule will be faithfully complied with.

Don't delay—investigate this most versatile of all products.

American Felt Company

BOSTON SAN FRANCISCO NEW YORK
DETROIT CHICAGO
PHILADELPHIA ST. LOUIS

AMERICAN FELT CO.
315 Fourth Ave.—N. Y. C.
We are interested in the use of felt.
Send sample for
☐ Have your representative call
Name
Address

AIRCRAFT SERVICE DIRECTORY

STATE UNIVERSAL SAW

(Patented)

Saws Wood or Metals

Complete Portable Universal Saw

For Aeronautical Work

STATE MFG. & ENG. CO.

2766 Fulton Street, Chicago

When in St. Louis

Store your plane in a steam heated hangar. Guaranteed repair work on any kind of motor or airplane. Recovering and painting. Work done by first class licensed mechanics and guaranteed to pass Dept. of Commerce license requirements. Authorized Klaxon Service Depot. Used planes for sale

Van Hoffman Aircraft Co.

Lambert-St. Louis Flying Field, St. Louis, Mo.

Nepco Announces

Complete Airplane and Motor Overhaul Depot

All Licensed Mechanics

Specializing in Recovering, Repairing and Repainting Airplanes

Major Overhaul of Wright, Lycoming, Kinner, Warner, Curtiss and Wasp Engines.

Write for prices. All Work Guaranteed

Nepco-TriCity Flying Service Inc.

Major L. G. Mulzer, *Vice-President*

WIS. RAPIDS, WIS.

TRIUMPH

MAGNETIC

FUEL GAGES FOR AIRCRAFT

NEW MODELS FOR COWL, WING OR SPECIAL TANKS

Manufactured by

THE BOSTON AUTO GAGE COMPANY

PITTSFIELD MASSACHUSETTS

AIRPLANE—SPRUCE—GLIDERS

Beech Green Kiln Dried Rough Air Dried or Finished to your sizes. Prompt shipments in carloads and less than carloads. We supply many of the largest manufacturers in the United States and Europe.

Specialists in Airplane Spruce since Aviation started

J. V. D. POSEY & COMPANY

Public Service Building PORTLAND, ORE.

PITCH INDICATORS

A dependable Flight Indicator is indispensable in aerial navigation.

We manufacture mechanical and Liquid types, from $6.00 up.

FRISBIE AIRCRAFT PRODUCTS

P. O. Box 389 New Haven, Conn.

TAIL SKID

For WACO, BIRD, ETC.

BEST SILICON MANGANESE STEEL

$2.95

TAIL SHOES

For TRAVEL AIR, EAGLE ROCK

WACO BIRD AMEAGLE

85c 2.50

AIR TRANSPORT EQUIPMENT INC. Garden City, N. Y.

FOR ADVERTISING RATES

in the "Aircraft Service Directory" of Aviation write to-

SEARCHLIGHT DEPT.

Tenth Ave. at 36th St., New York City

AY 81

PROFESSIONAL SERVICES

Youngberg, Brown & Youngberg

AIRPORT ENGINEERS

Designers of

Joliet (Illinois) Municipal Airport
Sky Harbor Bluffs Illinois
Muncie, Indiana
Green Bay, Wisconsin
Rock Island, Ill.
Iowa City, Iowa
Dubuque, Iowa
Sioux Falls, S. Dak.
Storm City, Iowa
Janesville, Wisconsin
Duluth, Minnesota

520 N. Michigan Ave.
Chicago, Illinois

National Aircraft Engineers, Inc.

Formerly Gazley and LaSha, Inc.

Consultants in Aeronautics

Aircraft Design — Engine Design
Stress Analysis — Factory Planning

Management of all matters between manufacturers and Department of Commerce

Hill Bldg., 17th and I Sts., N. W.
WASHINGTON, D. C.

This Service Directory

is designed to give you the kind of services that will be of real value to your business.

Take advantage of it

Patent Your Ideas

Send me a sketch or simple model of your invention. SATISFACTORY TERMS

Free Confidential advice Illustrated Literature

Z. H. POLACHEK PATENTS NEW YORK PATENT ATTORNEY

Z. H. Polachek, 1234 B'way, N. Y.

E. W. ROBERTS, M.E.

Gasoline and Oil Engines Exclusively

DESIGNS *and* CONSULTATIONS

Author The Gas Engine Handbook.
One time Staff Member N.A.C.A.
Thirty Years Experience — 116 Engine Designs

P.O. Box 1340 Cincinnati, Ohio

PATENTS—TRADE MARKS

All cases submitted given personal attention by a member of the firm. Information and booklet free

LANCASTER, ALLWINE & ROMMEL
PATENT LAW OFFICES
421 Ouray Bldg., Washington, D. C.

WHERE TO FLY

CALIFORNIA

NEW YORK CITY

MASTERS TEACH YOU

The world's oldest and greatest flying concern quickly and easily gives you command of the sky at Curtiss Wright Schools. Experts teach construction, service, and piloting. Write for details and we'll give you a letter of introduction to our nearest Flying School

IT'S EASY TO FLY WITH

CURTISS-WRIGHT FLYING SERVICE

27 West 57th Street, New York

PENNSYLVANIA

COMPLETE mechanical and flying instruction under Government license as to parts. Theory and practical shop work on latest types of planes and engines. Builds complete ships. Wm. Penn Airport is equipped to allow thorough training for all classes of licenses. Get license & plane, open cockpit type. Flying time required to permit earning part tuition at Airport. Address

WM. PENN AIRCRAFT SCHOOL

2001 Allegheny Ave., Philadelphia, Pa.

ILLINOIS

EAGLE AIRWAYS

P. E. Address Kinsley, Illinois, 50 miles West of Chicago

Learn to Fly at our new location on the Transcontinental Airways, DeKalb County Airport. Equipped for night flying, good equipment, Transport Pilots and excellent accommodations. Very reasonable rates. Distributors for Stinson Monoplanes. Monocoupes. Write for free information.

NEW YORK STATE

FLY NOW

AVIATION TRAINING

U. S. GOV APPROVED SCHOOL — AGENTS FOR Waco Stinson Leaning Fleet Travelair

D. W. FLYING SERVICE

LE ROY, N. Y.

DANIEL GUGGENHEIM SCHOOL OF AERONAUTICS

Graduate and Undergraduate Courses in Aeronautical Engineering and Air Transport. Particulars from Dean, College of Engineering

NEW YORK UNIVERSITY
University Heights, New York, N. Y.

YOU CAN NEW AFFORD A COURSE IN AVIATION

Learn Aeronautical Engineering, Aviation Mechanics, Airplane Welding, Drafting. Low Rates. Easy Terms. Day and Night Classes

INSTITUTION OF AERONAUTICS INC.
SOLE AGENTS OF FLYING INSTRUCTION
1780 Broadway (at 57th St.) New York

WISCONSIN

NEPCO

Dept. of Commerce—Approved Transport Ground and Flying School

Write for Information

Carl L. G. Mulzer, Wis. Rapids, Wis.

SEARCHLIGHT SECTION

FOR SALE

A LAWSON 3-place biplane. Engages A. C. wings just recovered. Federally licensed. Fly away. Arcola, N. J. 3068 B. Kenyon 345 Linwood Ave. Newtonville, Mass.

AIRPLANE for sale. OX-5 Allison, high lift wing on Curtiss fuselage. No Engine. Good ship for time. Will sell on easy payments to suit purchaser. Motor all instruments $500 ready to fly. Call Bloomfield 2 1748-J. 478 Abington Ave., East Orange, N. J.

BRAND new Curtiss OXX-6 motors for sale at bargain prices. Government rebuilt OX-5 motors and also new spare parts. Motors shipped with privilege of inspection. Aero Motor Sales Co., 500 East Jefferson Ave. Detroit, Mich.

CURTISS Sea Gull all metal hull N.C. license. July Hispano motor, self starter, 75 gallon gas tank, excellent condition, completely equipped, ready to go. Beautiful metal, would sell in Miami for $3,000. Must sell for cash $1,250. Write or wire for pictures. Paul Strasburg, Jefferson at Newport, Detroit, Mich.

C-6-A CURTISS motor for sale. Brand new in original case. No reasonable offer refused. Thropp Flying Service, Inc., Trenton, N. J.

FOR sale, OX Challenger, OX Waco, TM Scout, J-6 Kyan. All in first class condition, never cracked, always hangared. H. M. Peters, Ithaca Municipal Airport, Ithaca, N. Y.

FOR SALE

FOR SALE Heath parasol, nearly new, ready to fly or trade for two- or three-place plane. One exhibition parachute, $35. Joe Blase, 941 West 25th Street, Erie, Pa.

FOR SALE Stinson SM-1 5-8 seater, excellent condition. Travel Air 2,000 OXX-6 Kirkhamless motor, turns 2,000 r.p.m. Bennett Field, Binghamton, N. Y.

FOR SALE Licensed OX-5 Waco Tan. OXX-6 Travelair will trade for light car or air cooled plane. G. G. Imes, Fergus Falls, Minn.

FOR SALE Clark Y wing covered, spars 40 ft., slightly used, $100. Edward Kunesak, 3 W. Delaware Pl., Chicago, Ill.

FOR SALE Brand new Heath parasol, welded steel fuselage and tail, Clark Y wings all covered and doped, varnished wheels, lines and tubes. Reason for selling, owner going to college. Sacrifice at $360. John E. Beiler, Jr., Windsor, Ohio.

FOR SALE An Irwin biplane in good condition, newly painted and complete, but less motor, $150. A Henderson conversion, complete with prop and equipped with a Bendix generator and Schebler carburetor, $80. Write Albert W. Smobelle, 6 So. Walnut St., Beacon, N. Y.

FOR SALE Brand new Alco, Jr. exact scale plans, less motor, $5.00. A. M. Fox, U. S. Coast Guard, Galveston, Texas.

FOR SALE

BIRD OX-5 185 hours new airwheels, Pioneer compass and Airspeed indicator. Gorham Bosch magneto, Miller overhead dual controls. Perfect, $1,650. W. Field, Richfield Oil Co., Stratford, Conn.

165 Hp. Wright motor, new or type. Any offer over $1,000. Will ship for inspection. G. A. Yell, 269 Eastern Parkway, Brooklyn, N. Y.

FOR SALE OX-5 Jenny in good flying shape. Motor just overhauled. Price $400. Address Frank Cohen, Box 147, Connersville, Ind.

MONOCOUPE like new, many extras, 1931 license, to Aug. 1, 1931. Will take licensed OX-5 ship as part payment. Marvey Dexter, 818 West Washington Blvd., Fort Wayne, Ind.

FOR SALE J-6 165 horsepower Whirlwind Waco. Price $2,000. Ship has been used less than 150 hours and is equipped with many extras. For full details write R. L. Gregory, 2200 East 32nd Street, Kansas City, Missouri.

FOR SALE Lockheed Vega, powered with Wright J-6 300 hp. motor. Painted cream with vermilion markers. Motor has had only 150 hours. Ship never cracked up. A bargain at $7,500. Runway Wausau, Wis. Northern Airways, Inc.

PARACHUTE — Irvin seal pack, white silk, almost new. Price $200. P.S.24 Aviation Tenth Ave. at 36th Street, New York.

(Continued on the following page)

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or SPECIAL

UNDISPLAYED—RATE PER WORD
Positions Wanted 10 cents a word minimum amount $2.00 no insertion, payable in advance
Positions Vacant and all other classifications, including equipment, 10 cents a word, minimum charge $5.00 no insertion
Proposals 40 cents a line an insertion

INFORMATION
Box Numbers in care of our New York Chicago or San Francisco offices count 10 words additional in undisplayed ads
Discount of 10% if full payment is made in advance for ten consecutive insertions of undisplayed ads (not including proposals)

DISPLAYED—RATE PER INCH
1 inch — $3.00
2 inches — $2.75 an inch
4 inches — $2.50 an inch
Other spaces and contract rates on request
An advertising inch is measured vertically on one column 3 columns—30 inches—to a page

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL THE 15th FOR ISSUE OF FOLLOWING MONTH

Aviation

FOR SALE

(Continued from preceding page)

FOR SALE Six place Stinson Detroiter monoplane like new with 220 motor 4 gas tanks capacity 190 gal oversize 36x8 tires $4,000 also two OX 5 Waco 10s like new cruisers having 1 460 cu ground carry 30 lb oil pressure have 30x5 wheels and tires $1 400 each all ships have NC licenses West Avn Air Service Route 1 Menasha Wis

HANGAR T-shape sky tie sale or lease Opening 36 feet by 12 feet tail part 20 feet long 8 feet high Made by Truscon Only 10 months old in perfect condition has had 2 coats of paint Cost $850 The first $400 takes it Wire E J Roche 3713 Diversey Ave Chicago Illinois

HEATH converted Handerson complete with propeller and hub $150 26x4 wheels tires and tube complete $10 each OX-5 $220 Axanar 80 $980 David Reelis 742 Main St., South Manchester Conn

MONOCOUPE 90 Velie M-5 motor ship and motor in good shape unlicensed Price $725 Pease on request H T Richards 347 N Pacific Ave Cape Girardeau Mo

OX-5 CHALLENGER completely overhauled, airometer tachometer compass dual controls Miller action Must realize $900 at once Bargain Will demonstrate Yankee Flying Club Inc Branford Field Hartford Conn

PARACHUTES new and used rope ladders for stunt man etc Specify weight Thompson Bros Balloon and Parachute Co Aurora Illinois Established 1903

SPECIAL Waco racing plane 2-place clipped wings special OX-5 motor Must sell to make room No reasonable offer refused Thrope Flying Service Inc Trenton N J

WACO 10 OX N C license 977B 300 hours Just overhauled First class condition Privately owned Dual controls Will demonstrate Plane at Bridgeport Conn Price $900 O V Schlant, Box 513 Westport, Conn

WACO 10 Hammondsport OX-5 about 300 hours Purchased new with new motor Fitted with navigation and landing lights Also radio indicator Bosch starting magneto and set of new skids Never cracked Kept in hangar $1 900 cash R E Hotaling Transport 30663 14 Saratoga Blvd., Gloversville N Y

WRIGHT J-4 cylinders used and factory reconditioned all sizes 80% of list price Satisfaction guaranteed or money refunded Stout Air Services Inc Cleveland Airport Cleveland Ohio

WRIGHT-E-4 Travel Air—Model 3000 Travel Air fuselage with new Wright E-4 motor 2 Scintilla mags Thompson radio type valves standard steel prop brakes Dahlber Compass extra luggage carrier and dual controls Ship always kept under hangar has NC license and is in perfect condition Price $3 000 cash or $3 200 terms of $1 200 cash balance fully secured and payable within six months C E Ware Clearwater Florida

EQUIPMENT WANTED

NINE cylinder Siemens-Halske motor new or nearly new must be bargain Auto Electric & Radio Equip Co 134 Essex St Fort Wayne, Indiana

WANTED OX-5 airplane, motors motor motel be licensed and priced reasonably State condition and lowest cash price in reply Price Le Clare Congon Iowa

EQUIPMENT WANTED

WANTED Licensed plane, less motor OX jab Stats particulars in letter M S Cahn 330 Travis St., Shreveport La.

WANTED to buy A two-place, closed ship, Monocoupe or similar job Must be in good condition complete with instruments, brakes, etc Will consider good used ship Write what you have giving full description, how many hours flown and where it may be seen W18, Aviation, Tenth Ave at 36th Street, New York

TRADE

WILL trade new Dodge 8 sedan driven only 2 000 miles for good used ship what have you State terms in first letter T 19 Aviation 522 No Michigan Ave Chicago Ill

POSITION VACANT

WANTED transport pilot, must be good business man and hustler to take charge of established airport on paved main hangar Lombard Airport, Lombard Ill. R.F.D No 1

POSITIONS WANTED

MECHANIC licensed airplane and engine, Government trained eleven years experience in mechanics qualified instructor age thirty married (813 free) will go anywhere for permanent connection Solo or factory Mechanic 341 Albert Street Turtle Creek Pa

LIMITED commercial pilot, 5 years college single A O Medberg Fould Minn

PILOT wants position that pays little more than expenses is unable him to build up solo time Box 112 Hudson Michigan

TRANSPORT pilot experienced cross-country passenger and instruction work, 503 hours open cockpit cabin ships best references age twenty-five PW-20 Aviation Tenth Ave at 36th St New York

TRANSPORT pilot, Parks Air College graduate wishes position with firm or individual Holding A C and D C. solos Will go any where Single, age 26 PW 17 Aviation 920 No Michigan Ave Chicago Ill

TRANSPORT pilot Parks graduate 1 yrs years barnstorming and cross country, in 12 states Desires position and will go anywhere Address G M 3th 3rd Wood Main St Somerville N J

TRANSPORT pilot Army trained 23 700 hours Experience more than 30 types of ships, cross-country night flying flying and ground instruction Available immediately Go anywhere Any reasonable proposition Write or wire Owen O Kean Bethany Missouri P O Box 397

DRAFTSMAN ENGINEER, thorough experience especially flying boats Amphibians Best references PW 23, Aviation Tenth Ave at 36th Street, New York

SKILLED workman Four years building and repair of aircraft Know own shop Thoroughly capable Understand design stress work organization sales D C licensed Want job with hard work and opportunity PW 22 Aviation, 522 No Michigan Ave., Chicago Ill

TRANSPORT PILOT

Fourteen years experience land and seaplane open and closed cabin and Executive. Age 35 years Thorough knowledge all branches of flying Instructing Photographing etc
Also have Canadian licenses as pilot and Air Engineer
Now open for position in transport line or as instructor
PW 71 Aviation
Tenth Ave at 36th St New York City

BUSINESS OPPORTUNITIES

CORPORATE organizing and promoting of meritorious enterprises reorganizations mergers and new financing The Breakwater Company Inc 118 East 42nd St New York City

FLYING clubs attention Transport pilot No 272 experienced in school management will organize and instruct club, as will furnish equipment and instruction by hour H Brown 136-03 39th Ave Flushing N Y

Airport to Lease

Flying rights, approved airport eight miles from New Haven post office and Yale University situated on the Boston Post Road tremendous traffic pass field daily Trailer and bus service pass field to New Haven and Hartford every few minutes Field approximately 2 000 by 1 000 feet in length in the prevailing wind direction with good approaches P O Box 1747 New Haven Conn

BUSINESS OPPORTUNITIES

For Sale or Lease

Airport with two steel individual hangars, also office building H Kohlert Motor Sales St Charles Ill

MISCELLANEOUS

Airplane Photographs

All makes brilliant 8x10 heavy weight 2 for $1 parcel special group Ten $3 includes Wasp Boeing Curtiss Lockheed Sirius Travel Air Mystery ship Taper Wace Falcon air Ohlum log cabin are Bellanca, Ford Cessair Douglas Pearl Stearman Fleet Great Lakes, etc Send C O D John Sulles Stonghton Mass

LIGHTPLANE wheels 18x3 in 1 pair $15 with tires, tubes $33 pair 14x3 in $14 with tires tubes $35 1 pair 20x2 in stinchers $12 with tires tubes $22 all new in factory boxes Latest 30 page catalog and lightplane Log book two dials Kamm Aircraft Co 524 12th Street Oshkosh Wis

FOR RENT

Hangar space $10 per month
Lombard Airport, Lombard, Ill

LEGAL NOTICE

STATEMENT OF THE OWNERSHIP MANAGEMENT, CIRCULATION ETC REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24 1912

Of Aviation published monthly at New York N Y for October 1 1930

State of New York } ss.
County of New York }

Before me a Notary Public in and for the State and county aforesaid personally appeared C E Thompson who having been duly sworn according to law, deposes and says that he is Secretary of the McGraw Hill Publishing Company Inc. publishers of Aviation and that the following is, to the best of his knowledge and belief a true statement of the ownership management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption required by the Act of August 24 1912 embodied in section 411, Postal Laws and Regulations printed on the reverse of this form, to wit

1 That the names and addresses of the publisher editor managing editor and business managers are Publisher McGraw Hill Publishing Company Inc. 10th Ave. & 36th St. N Y C. Editor Edward P Warner 10th Ave & 36th St N Y C. Managing Editor C Hidney Bowen Jr 10th Ave. & 36th St. N Y C Business Manager Louis P Stahl 10th Ave. & 36th St N Y C

2 That the owner is (If owned by a corporation its name and address must be stated, and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation the names and addresses of the individual owners must be given If owned by a firm company or other unincorporated concern its name and address as well as those of each individual member must be given) McGraw Hill Publishing Company Inc. 10th Ave. & 36th St. N Y C. Stockholders of which are James H McGraw 10th Ave & 36th St. N Y C James E McGraw 10th Ave. & 36th St. N Y C James H McGraw Jr 10th Ave & 36th St N Y C James H McGraw Jr Trustee for Mary Geddes McGraw 10th Ave & 36th St. N Y C Trustees for Harold W McGraw, James H McGraw, Jr., Donald C McGraw 10th Ave & 36th St. N Y C Harold W McGraw Curtis W McGraw 370 Seventh Ave. N Y C. Donald C McGraw 10th Ave & 36th St. N Y C. Harold W McGraw 330 Madison Ave. N Y C. Anna Hayes Britton, 10th Ave & 36th St. N Y C. Mason Britton, 10th Ave. & 36th St. N Y C. Edgar Dworman 10th Ave. & 36th St. N Y C Grace W Maltren, 3440 Lakeview Ave. Chicago, Ill. J Malcolm Muir 8 Quarry Trust Co. New York Trustee for Lida Kelly min 884 Fifth Ave N Y C F S Winthrop III Clinton P Bogert 30 Broad St. N Y C Edwin Wiley 14th Ave & 36th St. N Y C. Goldman, Sachs & Co 16 Pine Street, N Y C.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages or other securities are (If there are none, so state.) None

4 That the two paragraphs next above giving the names of the owners, stockholders and security holders if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner, and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above is (This information is required from daily publications only)

C E THOMPSON Secretary
McGRAW HILL PUBLISHING COMPANY INC

Sworn to and subscribed before me this 30th day of September 1930

(Seal) H B BEHNKE,
Notary Public N Y Co. Clk's No. 97 Reg No 1894, Kings Co. Clk's No. 649 Reg No 1486
My Commission expires March 30 1931

FOR SALE

New Production Instruments New

1—Eclipse Starter Type E-3 with extension and crank handle for 220 hp motor $125
1—Scintilla Magnetos for Wright J5 each $125
2—Pioneer Turn and Bank Indicators with Vertical Tube $75
1—Elgin Compass, Type B-3 A, $35
1—Compass 2—Altimeters Oil Gauges Thermometers, Air Gauges
Wright J-4 Hisso Motor Parts
Have all Parts cores as new 18 Cylicrome Tulip Valves Assembly New Dixie 460 Mags each $35.
Complete P-1 Mains less bucks

Ingvalds School of Aviation
K D 10 Box 4210 Sacramento Cal

WRITE ORT

for his latest price list of bargains in airplanes, motors and parts of all descriptions A brand new $1 60 machinist's hammer free with every order over $7 60

KARL ORT, YORK, PA.

AMERICAN EAGLE

Cost $7 100 powered with J6 Whirlwind 220 has been flown 70 hrs always kept in hangar lots of extras and just like new Will sacrifice at $3 000

FLOYD FRUE
212 E Ludlwood San Antonio Tex

FOR SALE

CESSNA BW5

Four place Wright J 6 engine approx 200 hours since factory overhaul ship and engine excellent condition Price $2 400

BELLANCA AIRCRAFT CORPORATION
New Castle Del

FOR SALE—MOTOR

Absolutely new Wright-Gipsy with heavier than usual equipment in original shipping crate $870 for quick sale

GOLDEN EAGLE AIRCRAFT INC
Port Columbus Columbus, Ohio

FOR SALE

SPORT PLANE MOTOR

4 cylinder in-line 40 45 hp water cooled Motor Rebuilt Has heated and Kan in. Very low gas and oil consumption. Motor smooth with new prop and ready for installation Price quoted $100

FREDERICK W. McKEEX
Kent, Michigan

Airplane Engines — *For Sale*

17—Curtiss OX5 a 6—Curtiss OXX6 a
16—Hisso Model A a 8—Hisso Model E a
Rebuilt Block Tested and Run in. Send Description and Prices.
Curtiss OX5 and Hisso Parts.
Authorized Motor Parts and Service

HECKMAN MACHINE WORKS INC.
4600 W Lake St. Chicago Illinois.

Wasp and Hornet Engines

We offer for sale a limited number of used Wasp and Hornet engines at substantial price reductions.

The United Airports of Connecticut, Inc
Hartford Connecticut

FOR SALE

TRAVEL AIR

6 place cabin Monoplane Type 6000B with J6-300 motor also real room Has had but 75 hours. Price $12,000 Ten new over 34,000

WARD S. LENT, Poughkeepsie N Y

LITTLE ROCKET WINNER

of the All-American Air Derby, for quick sale.

State your best offer in the first letter.

COMMAND-AIRE, INC.
LITTLE ROCK, ARK.

FOR SALE

American Cirrus Engine with DePalma Super Charger, Fuel Pump, Standard Steel Propeller

Perfect condition A bargain if taken at once

ALSO

One Gypsy Cirrus Engine

Brand new having never been flown

Write to

VERN ROBERTS
c/o Mean-Aircraft Corp.
Moline Illinois

25% DISCOUNT

On 5 brand new **American Eagles** while they last Other real buys Lincoln, T P Warner 7, Arrow Sport Leiland.

BLOSSFIE FLYING SERVICE CO
Concordia Kansas

FOR SALE

OX-5 STANDARD

Completely rebuilt by experienced licensed mechanics Ready for cover and engine to be run in Priced very cheap

BASTIAN
3013 So Jefferson Ave St Louis Mo.

CHALLENGER BIPLANE

New Camel engine, Heywood starter Bendix wheels and brakes Curtiss lights and full set of instruments Plane never washed, always hangared, is in excellent shape. Price $6000 Will take merchandise, aircraft, only 30 Inc for $700

C. B. SMITH, 76 William St., New York.

FOR SALE

Bellanca CH—Wright J-5 Engine

Six place. Total time on ship and motor 254 hours, been no engine since overhaul 90 hours. Ship will be entirely reconditioned and sold for $8 000

BELLANCA AIRCRAFT CORPORATION
New Castle Del

MOTORS FOR SALE

1—J 6 Wright Whirlwind—75 hours $3000
1—J-4 Wright—Good Condition 300
1—Rolls-Royce Engine 200
80—OX 5 s—Used Condition Together with large quantity of parts 2000

FITCAIRN AIRCRAFT INC
Pitcairn Field Willow Grove, Pa

ALPHABETICAL INDEX

TO

ADVERTISEMENTS

Name	Page
Aeromarine Klemm Corp	33
Airmaure Co of America	31 33
American Felt Co.	37
American Gas Accumulator Co	44
American Propeller Co	13
American Ter Preßuste Co.	38
American Window Glass Co	34
Anchor Post Fence Co	65
Austin Company The	6
E G Corporation, The	39
Bakelite Corp.	42
Barnes Co., Wallace	68
Barnes, Gibson & Raymond, Inc.	38
Bellanca Aircraft Co	39
Bendix Aviation Corp & Subsidiaries	3
Bethlehem Steel Co	46
Bird Aircraft Corp.	5
Black & Decker Mfg Co.	38
Boeing Airplane Co	31
Boeing School of Aeronautics	39
Brunner Mfg Co.	63
Budd Wheel Co	63
Cleveland Pneumatic Tool Co.	43
Continental Aircraft Engine Co	16-17
Continental Oil Co.	64
Cyclone Fence Co	67
Duplate Corp, The	34
Eagle Ottawa Leather Co	34
Eclipse Aviation Corp	Fourth Cover
Ede Aircraft Corp.	38
Electric Storage Battery Co.	48
Fairchild Aviation Corp. & Subsidiaries	47
Fekkers Company, The	69
Ford Motor Co	14
General Electric Supply Company	13
Gibson Co The Wm D.	38
Gilmore Oil Co	38
Good Roads Machinery Co	62
Govro-Nelson Co	68
Gulf Refining Co	41
Holley Carburetor Co	78
International Nutype Tool Co	34
Ireland Aircraft, Inc	48
Jacobs Aircraft Engine Co	37
Jaeger Watch Co., Inc	38
Johns Manville Corp	48
Kelsey-Hayes Wheel Corp	11
Kinner Airplane & Motor Co	16
Los Angeles Chamber of Commerce	7
Marlen Machine Foundry & Supply Co.	38
Martin Co., The Glenn L.	Third Cover
McGraw-Hill Book Co	38
Norma Hoffmann Bearings Co	16

Packard Motor Car Co.	12
Page Fence Associates	71
Parker Kalon Corp.	69
Parks Air College	31
Pennzoil Company	18
Perry Anglen Mfg Co.	32
Pioneer Instrument Co	78
Pitcairn Cierva Autogiro Co. of America	3
Pratt & Whitney Aircraft Co	27
Pyrene Mfg Co.	36
Quaker State Oil Refining Co	26
Quincy Compressor Company	28
Radio-Marine Corp. of America	68
Raymond Mfg Co	70
Richfield Oil Co.	66
Roebling's Sons Co John A.	65
Scintilla Magneto Corp.	51-77
Searchlight	72-73 74-76
Service Steel Co	72
Sikorsky Aviation Corp.	30
Sky Specialties Corp.	45
Stanavo Specification Board	4-29
Standard Oil Co of N Y	14
Standard Pressed Steel Co	35
Standard Steel & Bearings Inc.	63
Star Compass Co	76
Stearman Aircraft Co.	28
Stromberg-Carlson Tel. Mfg Co.	32
Summerill Tubing Co	Second Cover
Thompson Products, Inc.	10
Timken Roller Bearing Co., The	9
U S. Air Compressor Co	33
Vought Corp, Chance	20
Wasp Aircraft Co.	67
Warner Aircraft Engine Co	62
Westinghouse Electric & Mfg Co.	60
White Dental Mfg Co., S S., The	73
Wright Aeronautical Corp.	29
Wyman-Gordon	2
Zapon Co., The	69

SEARCHLIGHT

Classified Advertising

BOOKS	74
POSITIONS VACANT	74
POSITIONS WANTED	74
MISCELLANEOUS	74
FOR LEASE	74
BUSINESS OPPORTUNITIES	74
REPRESENTATIVES WANTED	74
TRADE	74
USED AND SURPLUS EQUIPMENT	73 74-76
WANTED TO PURCHASE	74

AIRCRAFT SERVICE DIRECTORY

Air Transport Equip Co. Inc	72
Boslon Auto Gage Co	72
Frisble Aircraft Products	72
Negus Tri City Flying Service, Inc	72
Posey & Co., J. V. G	72
State Mfg & Eng Co	72
Von Hoffman Aircraft Co	72

PROFESSIONAL SERVICES

Lancaster Allwine & Rommel	72
National Aircraft Engineers, Inc	72
Polachek Z H	72
Roberts (M E) E W	72
Youngberg Brown & Youngberg	72

WHERE TO FLY

Page	73

CONSOLIDATED INSTRUMENTS

BENDIX Aviation Corporation has purchased the assets of the Consolidated Instrument Company of America, Inc., and has arranged for the sale of Consolidated Instruments and panels by the Pioneer Instrument Company, a division of Bendix Aviation Corporation.

Consolidated Instruments and Panels are now sold through Pioneer offices and service stations at the following points:

GARDEN CITY, N. Y.	PIONEER INSTRUMENT COMPANY Roosevelt Field No. 2 Tel: Garden City 8753
CHICAGO, ILLINOIS	PIONEER INSTRUMENT COMPANY 5226 West 63rd Street Tel: Prospect 8184
WICHITA, KANSAS	PIONEER INSTRUMENT COMPANY 420 West Douglas Street Tel: 4-5450
DEARBORN, MICH.	WINGS, INC. 309 Dearborn Building Tel: Dearborn 99
LOS ANGELES, CALIF.	PACIFIC SCIENTIFIC COMPANY 451 Bendix Building Tel: Westmore 4358
SAN FRANCISCO, CAL.	PACIFIC SCIENTIFIC COMPANY 15 Spear Street Tel: Davenport 0955

Orders and inquiries for Consolidated Instruments and Panels should now be addressed to:

PIONEER INSTRUMENT COMPANY

INCORPORATED • • • DIVISION OF BENDIX AVIATION CORPORATION

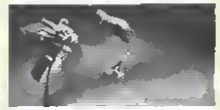
754 LEXINGTON AVENUE • • • BROOKLYN NEW YORK

309 DEARBORN BLDG., DEARBORN • BENDIX BUILDING, LOS ANGELES • 15 SPEAR ST., SAN FRANCISCO • 420 W. DOUGLAS ST., WICHITA • 5034 W. 63rd ST., CHICAGO
827 ROBERT ST., OTTAWA • STERNPLATZ 15, JOHANNISTHAL, BERLIN • GENERAL EUROPEAN REPRESENTATIVE, M. CALDERARA, 11 RUE MONTAIGNE, PARIS

NOT A SIGN OF CORROSION!

after Two years South with the Fleet

The ar[illegible] is mad[illegible] alloy [illegible] It is [illegible] standard practice in the Martin Plant. It is an excellent strengthening and protective process. It also has the valuable characteristic of preparing the metal to receive Martin's famous 3-coat anti-rub and other anti-corrosion finishes.



To prevent corrosion each part of every Martin plane is given a separate coat of [illegible] paint immediately after [illegible] and before assembly. Further [illegible] is applied after assembly. And all parts that come in contact with wing fabric are wrapped with pure aluminum foil.

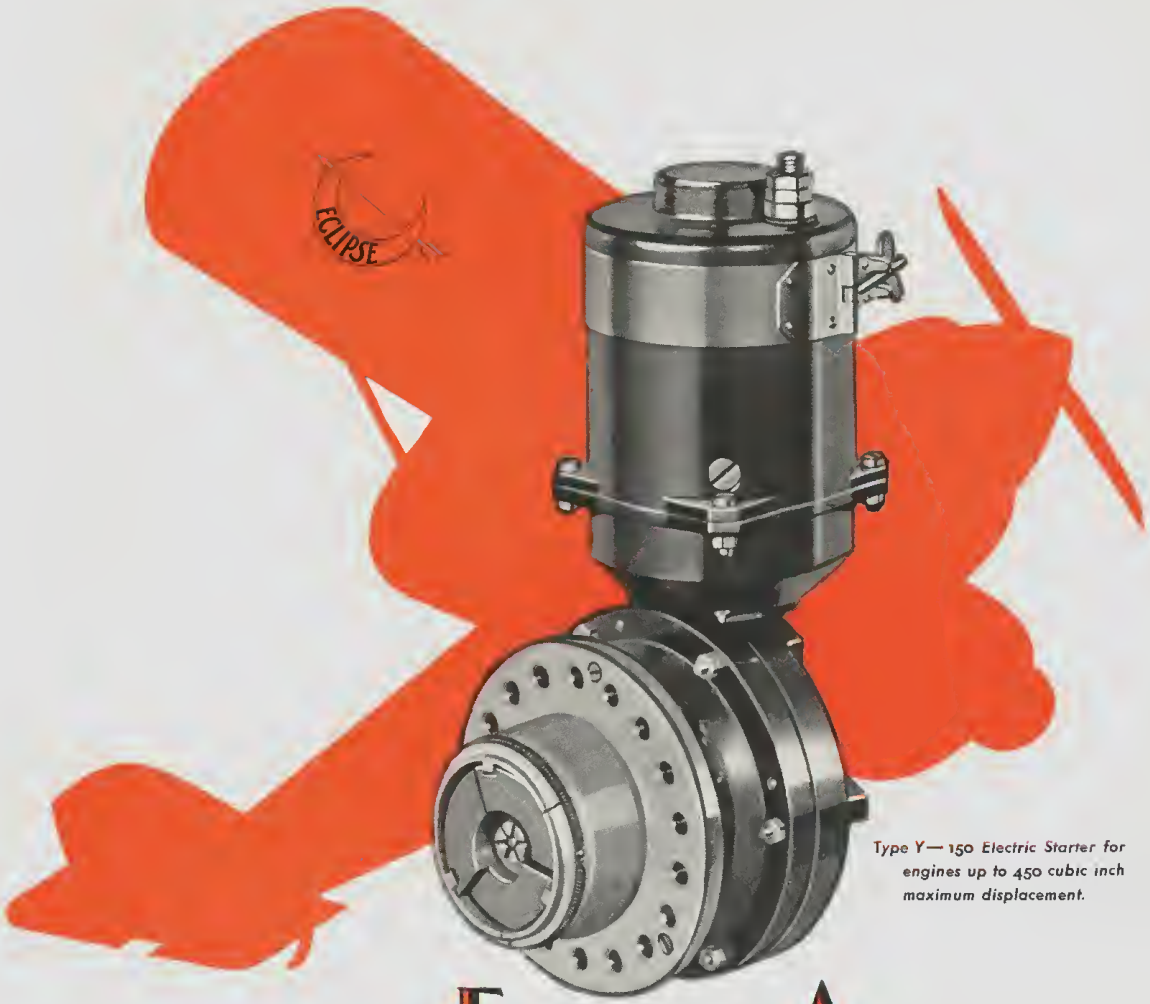
The [illegible] at PM-1, the [illegible] patrol bomber. Fifty-two [illegible] similar to this and ten other planes are now being built by the Martin Company for the U. S. Navy.

CORROSION was once considered an unavoidable menace to aircraft made of aluminum alloys. But it is no longer! A dramatic demonstration of the Martin Company's conquest of corrosion is seen in the history of over 100 Martin Torpedo and Bombing planes (T4M-1) built for the Navy. They have proved their ability to win in the ceaseless battle with corrosion when at sea.

These Naval planes, made entirely of aluminum alloy, are constantly exposed to severe corrosive action. After the last maneuvers of the fleet, when the planes returned to their base, careful examination by Naval inspectors found them in almost perfect condition. According to the Naval report "No corrosion of any sort was noted."

Vast research and long experimentation with anti-corrosion finishing processes were responsible for this remarkable record of Martin planes. The Martin Company, however, is never satisfied to rest on its laurels, and has since made still greater progress in preventing corrosion of aluminum alloy aircraft. THE GLENN L. MARTIN COMPANY, *Builders of Dependable Aircraft Since 1909*, Baltimore, Md., U. S. A.

MARTIN AIRCRAFT



Type Y— 150 Electric Starter for engines up to 450 cubic inch maximum displacement.

ECLIPSE AIRCRAFT ENGINE STARTERS AND GENERATORS

Instantaneaus starting may be accamplished with engines equipped with the Type Y 150 Electric Starter. This unit is of the direct cranking type, applicable to engines having a maximum piston displacement of 450 cubic inches, and provided with standard 5-inch diameter mounting flange.

Immediately upon closure of the battery circuit, automatically the starter is connected ta—and rapidly cranks the engine; starting is practically instantaneaus. Disengagement is effected the instant that the engine fires.

The starter weighs 16¼ lbs., and is provided with protection against engine backfire.

Eclipse Starters and Generatars are available in various sizes, suitable for most modern engines. Details upon request.

ECLIPSE AVIATION CORPORATION

EAST ORANGE · NEW JERSEY

(DIVISION OF BENDIX AVIATION CORPORATION)